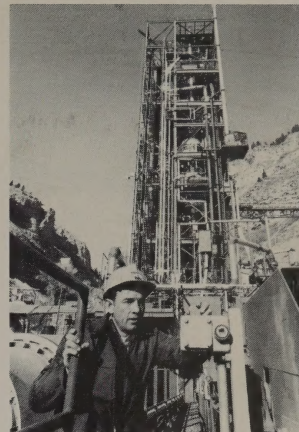
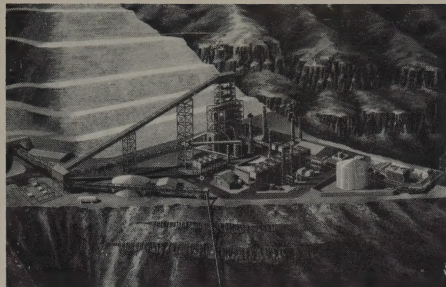


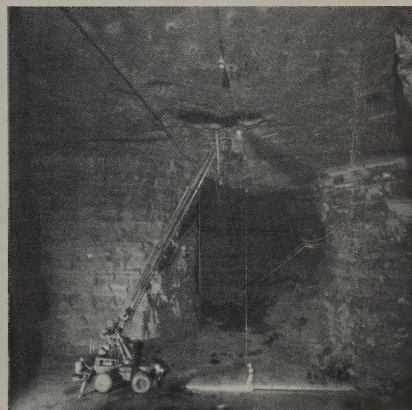
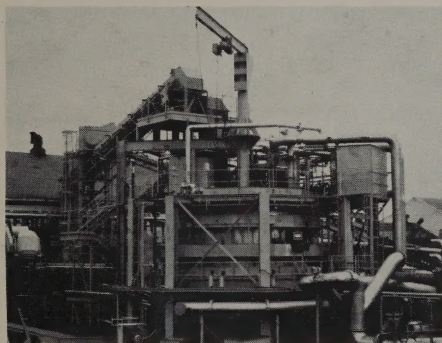


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OIL SHALE



PROJECTS



United States Department of Energy

April 1981

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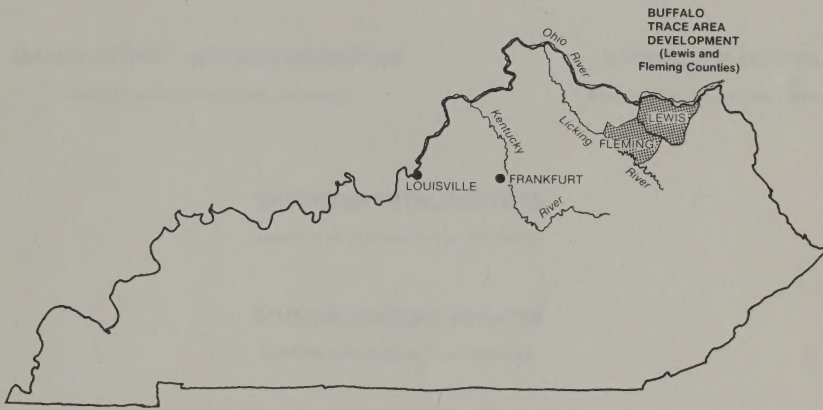
OIL SHALE PROJECTS

Office of Shale Resource Applications
U.S. Department of Energy

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Buffalo Trace



KENTUCKY

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil	Sponsor:	Buffalo Trace Area Development District
Production:	10,000 BPD (minimum)	Contractor:	Davy McKee Corporation, Cleveland Cliffs, University of Kentucky Institute of Mines and Minerals
Input Material:		Manager:	Stephen H. Miller
Process:	Paraho and IGT Hytort Processes are being considered	Phone:	(606) 564-6894
		Location:	327 West Second Street, Maysville, Kentucky 41056
Location:	Fleming and Lewis Counties, Kentucky	Key Contact:	Stephen H. Miller
Current Status:		Funds Expended:	Not Available
		Total Estimated Capital Required:	Not Available
		Financing Plan:	\$50,000 to Buffalo Trace Area Development District for project administration and review of study findings; \$300,000 to primary contractor; \$350,000 - TOTAL

MAJOR PERMIT ACTIONS/DECISIONS

Kentucky regulations are under preparation.

PRODUCT MARKETS

Shale oil, High Btu gas, and Electricity

ENVIRONMENTAL IMPACTS

Less than or equivalent to coal operations.

SOCIOECONOMIC IMPACTS

Expected to be positive for area selected.

PROJECT HISTORY AND STATUS

The purpose of this feasibility study was to provide information and more accurate cost estimates on commercial production of synthetic crude oil from Eastern Devonian oil shale deposits by evaluating the resource quality of sample oil shales processed by alternative technologies. This study was an objective assessment of the procedures and costs required to obtain synthetic fuel from oil shale as efficiently as possible, and recommend commercial means to produce 10,000 barrels of synthetic fuel per day by 1985. The program sponsor is trying to coordinate local response to federal interest in the rapid development of fuel production from domestic natural resources—especially oil shale. The Buffalo Trace Area Development District sponsored, by way of grant funds from DOE, a study that evaluated the practicality of mining and processing oil shale in Eastern Kentucky to take advantage of the area's natural resources and labor availability. Mining and processing oil shale and the abundant oil shale deposits of Eastern Kentucky were assessed by a consultant without vested interest in order to demonstrate to both government and private industry that such a venture is feasible. The feasibility study report is available as guidance to industry, government, and the local participants working on similar projects.

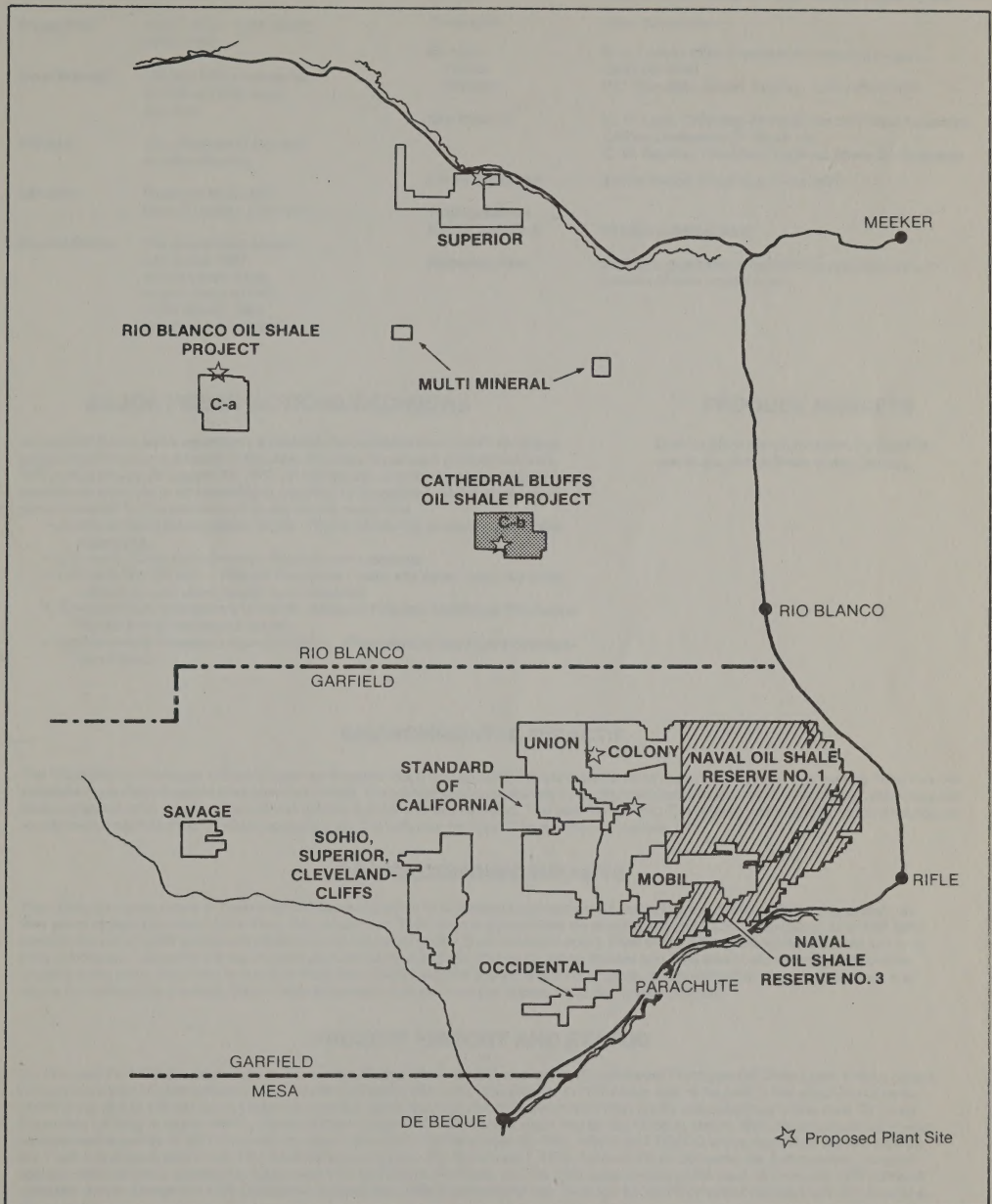
PROJECT/PROCESS DESCRIPTION

The primary benefit from the study was to identify the potential oil shale processing technologies available and applicable to Eastern Devonian oil shale, as evidenced by shales extracted and sampled from Lewis and Fleming Counties. The potential processes were identified and evaluated with standard criteria for evaluation. Product flow sheets depict each of the selected candidate technologies applied to the selected shale deposit. A summary with detailed operating conditions, material and energy balances, compositional analysis, and hydrocarbon yield is included. The two-volume study report is available from the Buffalo Trace Area Development District office in Maysville, Kentucky.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

(Future activity depends upon finding a sponsor for the project.)

Cathedral Bluffs (C-b)



COLORADO

PLANT TYPE

Product: Shale oil

Production: 55,000 BPD - 1986, 94,000 BPD - 1990

Input Material: 166,000 TPD oil shale and 10 million GPD water required

Process: Oxy modified in situ and surface retorting

Location: Piceance Basin, Rio Blanco County, Colorado

Current Status: Site preparation began: September 1977
Actual construction began: January 1978
Initial retorts: 1985
Full Production: 1990

MANAGEMENT AND FINANCE

Sponsor: Occidental Oil Shale, Inc. and Tenneco Shale Oil, Inc.

Contractor: Fluor Corporation

Manager: R. A. Loucks (Vice President & Project Manager)

Phone: (303) 242-8463

Location: P.O. Box 2687, Grand Junction, Colorado 81502

Key Contact: W. H. Love, Chairman of the Board and Chief Executive Officer, Occidental Oil Shale Inc.
C. W. Rackley, President, Tenneco Shale Oil Company

Funds Expended: \$117.8 million (Tract C-b Lease Bid)

Total Estimated Capital Required: \$3 billion (1980 dollars)

Financing Plan: SFC loan guarantee requested for approximately 75 percent of total project cost

MAJOR PERMIT ACTIONS/DECISIONS

As required by the lease agreement, a detailed Development Plan (DDP) for above-ground retorting was submitted to the Area Oil Shale Supervisor (AOSS) in March 1977 and approved on August 30, 1977. An update allowing the combined above-ground and modified in situ retorting is currently in preparation. Major government permits needed for the commercial phase of this project are:

- Bureau of Land Management (BLM) - Rights-of-way for product pipeline and power lines
- U.S. Army Corps of Engineers - Pipeline river crossings
- Colorado Department of Natural Resources - wells and water use; land reclamation, air and water quality to be obtained
- Colorado State Department of Health -National Pollutant Discharge Elimination Permit and air emissions permits
- Environmental Protection Agency (EPA) - Prevention of Significant Deterioration Permit

PRODUCT MARKETS

Current plans are to transport, by pipeline, raw shale oil to refiners and/or utilities.

ENVIRONMENTAL IMPACTS

The "Final EIS for Prototype Oil Shale Leasing Program" (DOI August 1973) covers projects on all prototype lease tracts, including Tract C-b. An extensive 2-year baseline study has been completed. The present plan includes raw shale disposal onsite. Revegetation of the raw oil shale disposal area is planned, and much of the original wildlife habitat will be protected. The land in the Tract C-b region was changed to improve natural vegetation for wildlife; thus, oil shale operations on C-b will have no impact on regional agriculture.

SOCIOECONOMIC IMPACTS

The Colorado communities of Meeker and Rifle are expected to experience socioeconomic impacts upon development of this project, as they are in closest proximity to the Tract C-b project site. Their current populations are about 3,450 and 2,350, respectively. At 94,000 BPD production, about 1,600 permanent employees are expected (2,200 at construction peak). Most of the new residents are expected to live in Rifle and Meeker, but some will live in other parts of Garfield and Rio Blanco counties. Meeker and Rifle also could be impacted by other projects in the same area. Rifle is close to the Union, Colony and Rio Blanco Shale Oil projects, and is located on the major highway and also is the railhead for the area. Meeker also will receive impacts from the Superior and Rio Blanco projects.

PROJECT HISTORY AND STATUS

On February 21, 1974, the original project sponsors (Tosco, Shell, ARCO, and Ashland) purchased Prototype Oil Shale Lease C-b by closed bid sale from the U.S. Department of the Interior in Denver, Colorado. The price of \$177.8 million was to be paid in five equal installments (5,094 acres @ \$23,100 per acre). Under terms of the lease, the Preliminary Development Plan (PDP) was submitted to the Area Oil Shale Supervisor (AOSS) in March 1974. A Detailed Development Plan (DDP) was submitted to the AOSS in March 1977. Commencement of site development activities in 1977 followed approval of the DDP. On December 19, 1975, ARCO and TOSCO announced their withdrawal from the Tract C-b project, and in late 1976 Shell Oil also withdrew. On December 1, 1976, Ashland Oil of Colorado, the last remaining original sponsor, entered into a partnership agreement with Occidental Oil Shale, Inc., for joint development of the tract. In February 1979 Ashland withdrew, and in September 1979 Occidental entered into a 50-50 partnership with Tenneco for development of the tract with Occidental as the operator.

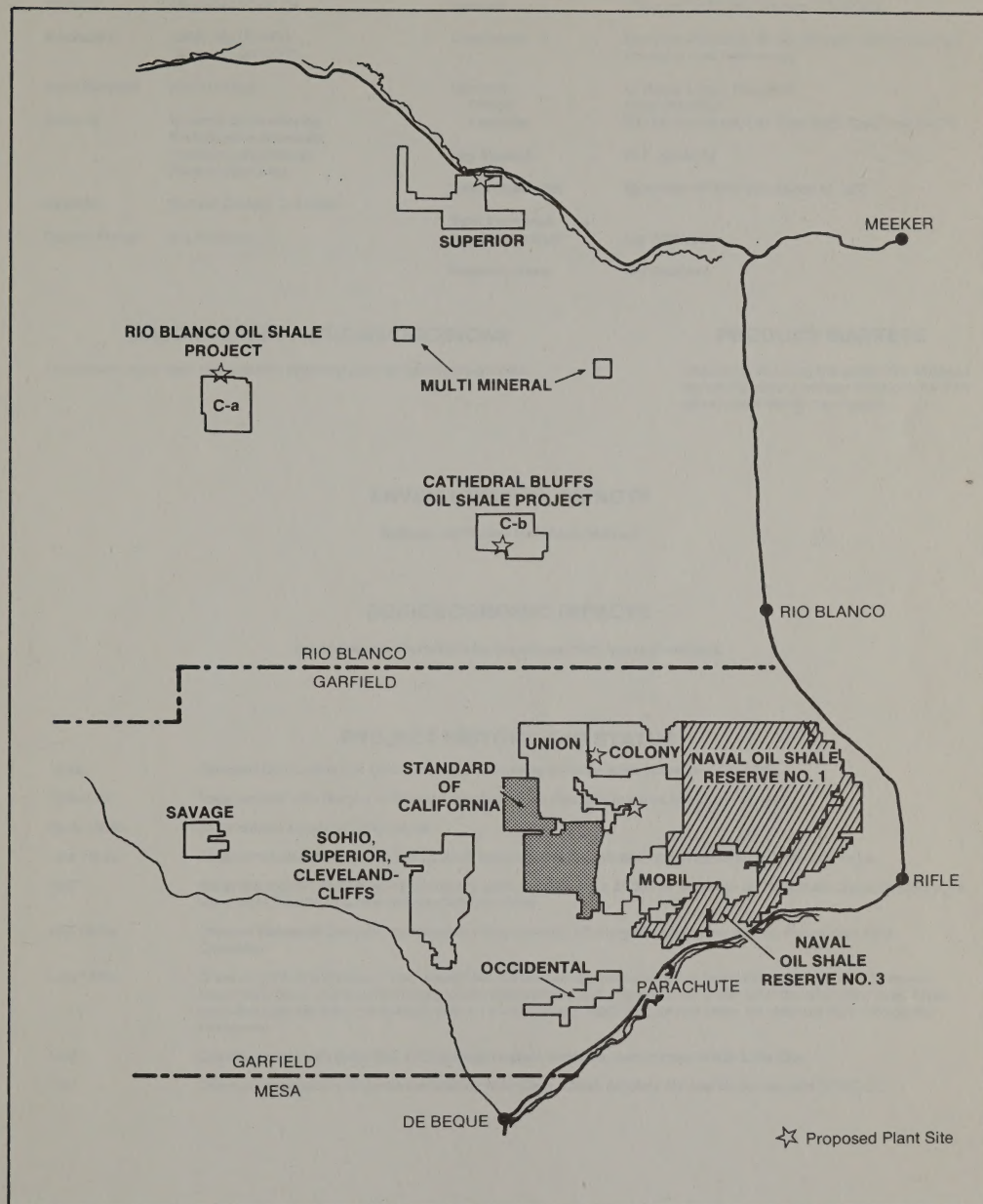
Cathedral Bluffs (C-b)

PROJECT/PROCESS DESCRIPTION

Federal Prototype Oil Shale Lease Tract C-b is located in the center of the Piceance Creek Basin of northwestern Colorado. The 5,094-acre tract has a present potential recoverable shale oil reserve of approximately 1.2 billion barrels (27 GPT). Overburden thickness is about 1,250 feet on the tract, requiring an underground mining plan. Site preparation work commenced on September 1, 1977, and shaft sinking operations in February 1978. Three large diameter shafts are in process: a 15'-diameter ventilation/ escape shaft, a 29'-diameter production shaft, and a 34'-diameter service shaft. A fourth shaft (34'-diameter) will be completed in December 1986 to handle offgases from the commercial retorts. Aboveground retorting of the shale mined from the in situ retorts will result in a total estimated production rate of about 94,000 BPD.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

[illegible]



PLANT TYPE**MANAGEMENT AND FINANCE**

Product:	Upgraded Shale Oil	Sponsor:	Chevron Oil Shale Company, CONOCO
Production:	1989 - 50,000 BPD 1992 - 100,000 BPD	Contractor:	Morrison-Knudsen; Foster-Wheeler; Environmental Research and Technology
Input Material:	Not Available	Manager:	D. Roger Loper, President
Process:	Chevron is considering the following processes: Chevron (proprietary); Paraho; and Lurgi	Phone:	(415) 894-5983
		Location:	595 Market Street, San Francisco, California 94105
Location:	Garfield County, Colorado	Key Contact:	R. F. Schlecht
Current Status:	Not Available	Funds Expended:	\$5 million in 1979, \$20 million in 1980
		Total Estimated Capital Required:	Not Available
		Financing Plan:	Not Available

MAJOR PERMIT ACTIONS/DECISIONS

Discussions have been initiated with state and local government agencies.

PRODUCT MARKETS

Chevron is pursuing the project for strategic reasons to assure refinery feedstock for their refinery and distribution system.

ENVIRONMENTAL IMPACTS

Background studies have been initiated.

SOCIOECONOMIC IMPACTS

Schedules and alternatives for development are being considered.

PROJECT HISTORY AND STATUS

1930s	Standard Oil Company of California began acquiring oil shale lands in western Colorado.
1948-1950	Socal worked with Bureau of Mines in developing the Gas Combustion Retorting Process.
Early 1950s	Socal started acquiring water rights.
Late 1950s	Socal conducted core drilling and isopach mapping and consolidated holdings through land exchanges.
1967	Socal (Pacific Oil) and Union Oil Company applied jointly for a 34,000 AF reservoir on Parachute Creek for storage of water from Parachute Creek and the Colorado River.
Mid-1970s	Chevron Research Company participated in the Paraho's retorting demonstration at Anvil Points near Rifle, Colorado.
Late 1970s	Chevron Oil Shale Company was formed and conducted resource evaluation work. Chevron Research Company began pilot plant phase of retorting process development and upgraded raw shale oil at the pilot plant level. Chevron's Salt Lake Refinery processed, over a two-day period, 3,000 bbls. of raw shale oil obtained from Occidental Petroleum.
1980	Chevron announced that a 350 TPD semiworks plant would be constructed in Salt Lake City.
1981	Chevron exchanged a 30 percent interest in their Clear Creek property for coal resources with CONOCO.

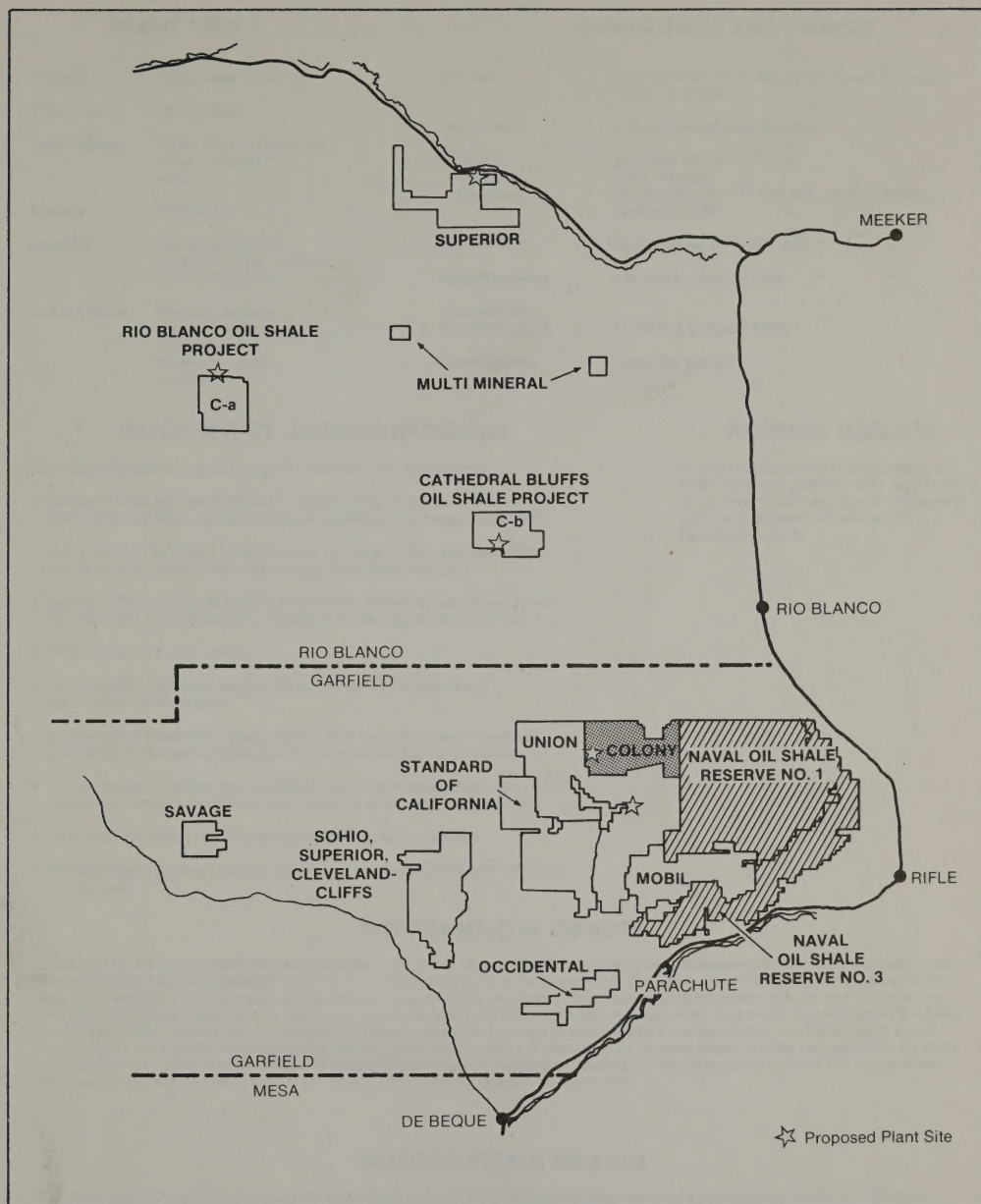
PROJECT/PROCESS DESCRIPTION

Chevron Oil Shale Company currently owns 43,000 acres of oil shale property in the Roan Plateau area of northwestern Colorado. In February 1980, Chevron Oil Shale Company began conducting feasibility studies aimed at commercial development of its Colorado property. These feasibility studies were contracted to Morrison-Knudsen with Foster-Wheeler Energy Corporation as its prime subcontractor. These studies, which will extend over an 18-month period, consist primarily of retorting process analysis, mining studies, site selection, and socio-economic impact evaluation. In addition to these studies, the baseline monitoring work required for permitting activities will be performed by Environmental Research and Technology, Inc. In the summer of 1980, a field core drilling program will be conducted to more accurately evaluate resources and to provide design information for mining activities. The site is expected to be producing 50,000 BPD of shale oil by late 1989 with a total 100,000 BPD by 1992. These dates are based on a successful demonstration of retorting process technology by 1985 and appropriate financial incentives being available. In order for Chevron to handle a project of this size, a concerted effort to expand its staff has begun. In April 1980, Mr. D. Roger Loper was named President of Chevron Oil Shale Company.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

ACTIVITY	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Feasibility Studies										
Test & Development										
Production (B/D)										

(50,000)



PLANT TYPE

Product: Hydrotreated shale oil

Production: 48,300 BPSD

Input Material: 66,000 TPD of 35 GPT oil shale; 10,000 AF/Y of water

Process: TOSCO II

Location: Fee land at head of Parachute Creek, Garfield County, Colorado

Current Status: Planning, detailed engineering design and costs complete; construction has commenced

MANAGEMENT AND FINANCE

Sponsor: Colony Development Operation (Exxon 60 percent, Tosco 40 percent)

Contractor: Colony Development Operation

Manager: Lawrence Hayes
Phone: (303) 245-6907
Location: 759 Horizon Dr., P.O. Box 308, Grand Junction, Colorado 81502

Key Contact: Frank Barrow, (713) 856-1553

Funds Expended: \$75 million (January 1980)

Total Estimated Capital Required: \$1.7 billion (January 1980)

Financing Plan: Tosco has applied

MAJOR PERMIT ACTIONS/DECISIONS

Final EIS approved and issued mid-1977. Permits status is as follows:

- Bureau of Land Management (BLM) - Right-of-way for products pipeline and power lines submitted, action pending announcement of project reactivation.
- U.S. Corps of Engineers - Colorado River Crossing by the products pipeline and plant water intake facility near Grand Valley permit issued.
- Bureau of Reclamation (BUREC) - Contract for delivery of water from Green Mountain and Ruedi Reservoirs - request to reopen negotiations submitted.
- State Emissions permit issued.
- Environmental Protection Agency (EPA) - Prevention of Significant Deterioration Permit issued.
- Environmental Protection Agency (EPA) - Spill prevention countermeasure plan (must be filed within 6 months after completion of storage facilities).
- Environmental Protection Agency (EPA) - National Pollutant Discharge Elimination System for quality of water effluents to be submitted if needed.
- Colorado State Mined Land Reclamation Permit - Being prepared.
- Colorado State Engineer - Construction water well, construction and water use - approved.

PRODUCT MARKETS

Product markets will be transportation and boiler fuel users primarily, with some heating oil and petrochemical usage. Byproducts of sulfur and ammonia will be used by traditional markets.

ENVIRONMENTAL IMPACTS

A final EIS for the Colony Plant has been prepared by BLM and issued mid-1977. Bureau of Land Management (BLM) Environmental Impact Statement (EIS) includes consideration of 194-mile, 50,000 BPD pipeline to Lisbon, Utah. The Colony Plant has no discharge of liquid effluents. Air effluent discharge complies with all federal, state, and local regulations. Sulfur compounds generated with the process are routed by Claus and Wellman-Lord units for processing; elemental sulfur is produced for sale as a byproduct. Byproduct ammonia is also produced by the Wastewater Treating Unit. The disposal of spent shale will be disposed of continuously at various locations in Davis Gulch, a high shallow valley in the northwestern portion of Colony's Dow West property. Topsoil may be removed ahead of filling and stockpiled for reuse in reclamation of the 800-acre disposal area. Revegetation (irrigation, fertilization, seeding) of the entire area is planned and would reestablish much of the original wildlife habitat disturbed during plant construction and operation.

SOCIOECONOMIC IMPACTS

The three counties expected to receive the major direct impacts of the proposed development had a population of 75,000 in 1975. Mesa County had about 55,000 residents, Garfield County had 15,000, and Rio Blanco County had 5,000. Current population levels are substantially higher. A planned community for plant employees and supportive infrastructure has been designed for land purchased by the project near Grand Valley, Colorado. Peak plant/mine construction employment of 2,400 is anticipated. Operation work force will be 1,200. Population increases in Garfield and Mesa Counties resulting from this project range between 3,000 and 4,500 (6.0% net increase) with total population increase at peak construction ranging to 12,000.

PROJECT HISTORY AND STATUS

The Colony Group has demonstrated retorting technology at Parachute Creek in a 1,000 TPD semi-works plant. Approximately \$75 million in research and engineering has been invested to bring the project to commercial readiness. Detailed engineering design and cost estimates for a commercial 66,000 TPD commercial plant have been completed. The Colony Development Company was formed in 1964 by Tosco (30%), Cleveland Cliffs (30%) and SOHIO (40%) to develop a commercial oil shale facility on 4,400 acres of fee land known as the Dow West Property. The property, purchased in 1964, is located at the head of Parachute Creek, Garfield County, Colorado (R95W, T5S). Total reserves of property are not available. Other properties are owned by Colony or its venture participants. A prototype Tosco retort was operated on Parachute Creek between 1965 and 1967 as well as a development mine. In 1969 ARCO joined the venture and the semi-works plant (TOSCO II) was operated between 1970 and 1972 (Cliffs and SOHIO withdrew in 1971 and relinquished all interest in the property in 1974). Extensive environmental and engineering studies were conducted. The planned construction start was suspended in October 1974 and resumed in 1980, after Exxon purchased ARCO's share of the project in August. Construction of the site access road and mine bench commenced in June 1980, and is scheduled for completion early in 1981. Detailed design and cost estimates for the commercial-scale Colony plant were prepared by C. F. Braun & Co. in 1974 at a cost of more than \$12 million and were updated by C. F. Braun in 1979.

PROJECT/PROCESS DESCRIPTION

The Colony project will utilize underground room-and-pillar mining. TOSCO II retorting (see reference 3) and conventional refining methods to produce a premium quality synthetic oil. The TOSCO II process recovers 100% of the Fischer Assay oil contained in the mined shale. Colony Development Operation proposed to construct, on the Dow West property, the following: (1) An underground oil shale mine of over 4,000 acres capable of producing 66,000 TPD of raw oil shale for a 20-year period, and a mine bench with primary crushing facilities. (2) An oil shale plant (TOSCO II) consisting of retorting and upgrading facilities which are capable of producing 47,000 BPD of low sulfur fuel oil, 4,330 BPD of liquefied petroleum gas (LPG), 135 TPD of ammonia, 173 TPD of sulfur, and 800 short TPD of coke, for a 20-year period. (3) A disposal area of about 800 acres in Davis Gulch to hold processed shale. (4) Two small reservoirs, one each in Davis Gulch and Middle Fork, for drainages. Additional actions proposed by the applicant, but which may not be entirely on the Dow West Property, include: (5) a 194-mile, 16-inch pipeline for transportation of low sulfur fuel from the plant site to a 120,000 barrel floating roof storage tank to be constructed from the Lisbon Valley Station in Utah. (6) Development of a 15-mile-long service corridor in Parachute Creek Valley from the plant site to associated facilities located north of the town of Grand Valley, Colorado. The corridor will include three pipelines (water, ammonia, LPG), and a paved two-lane highway. (7) Terminal/storage facilities to be located at the Grand Valley end of the service corridor, and a railroad spurt line to these facilities. (8) Two 230 kv power lines which may be built by Public Service Company to service the plant and mine. It is necessary to provide 100% of the plant's ultimate electrical requirements. (9) An exchange with the Federal Government of approximately 337 acres of Federal lands, consisting of isolated parcels located within or projected into the Dow West property, for private lands adjacent to the Naval Oil Shale Reserves. (10) Diversion of 12.5 cubic feet per second of water from the Colorado River at Grand Valley which will be piped to the plant site and planned community. This diversion is contingent upon a proposed contract with the U.S. Bureau of Reclamation for water from Green Mountain or Ruedi Reservoirs. (11) Plans for reclamation at the end of the projected 20-year plant life will be subject to State reclamation standards. Plans will be submitted to the Mined Land Reclamation Board in 1979. Some possibilities are complete removal of plant facilities and rehabilitation of the area, or "moth balling" of the facilities. Implementation of the preceding proposals would require a number of actions by governmental agencies.

The TOSCO II retort process functions as follows: Inclined rotating retort supplied with crushed shale, preheated with flue gas, and with hog 1/2"-diameter ceramic balls, preheated with product gas from the retort in a ball heater; retort effluent passes to a vertical accumulator vessel where overhead vapors are separated into gas and liquid products; the warm ball are withdrawn by means of the rotating trommel, and the spent shale is withdrawn as bottoms; operating temperatures are about 900F.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

ACTIVITY	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Planning & Design												
Construction												
Operation												
Production (BPD)												

Start up & Shakedown

(45,000)

(NOTE: Schedule shows earliest possible gear up. Reactivation, however, depends upon availability of sufficient financial incentives and no major permit delays.)

(Map Not Available)

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale Oil	Sponsor:	Equity Oil Company and the Department of Energy
Production:	Not applicable at this time	Contractor:	
Input Material:		Manager:	Paul M. Dougan, Project Manager
Process:	Superheated steam to retort in situ	Phone:	(801) 521-3515
Location:	Piceance Creek Basin of northwestern Colorado	Location:	Suite 806, 10 West 3rd South, Salt Lake City, Utah 84101
Current Status:	Technical feasibility demonstration project commenced March 1977 and scheduled to conclude in early 1982.	Key Contact:	Dallas Goodrich, Project Field Superintendent
		Funds Expended:	Not Available
		Total Estimated Capital Required:	Not Available
		Financing Plan:	Under a cooperative agreement, Equity pays 14 percent of the cost of the project, with the U.S. Government defraying the remaining 86 percent of the \$11 million plus expense budget.

MAJOR PERMIT ACTIONS/DECISIONS

Not available

PRODUCT MARKETS

Not available

ENVIRONMENTAL IMPACTS

Not available

SOCIOECONOMIC IMPACTS

Not available

PROJECT HISTORY AND STATUS

Equity Oil Company's knowledge of the existence and characteristics of the leached zone was gained initially in the course of drilling oil and gas exploration wells in the central Piceance Creek Basin during the early 1950s. The late J. L. Dougan, former president of Equity Oil Company, in 1961 conceived the idea that shale oil contained in the leached zone could be recovered by heating the shale in place using hot natural gas. To validate Mr. Dougan's theory, Equity Oil Company inaugurated an oil shale research program that was to continue for 10 years. This program included five years of laboratory research conducted at the Fuels Engineering Department of the University of Utah and seven years of field work performed at the BX In Situ Oil Shale Project site in Rio Blanco County, Colorado. The BX project and attendant laboratory work were discontinued in 1971 because of a lack of funding.

A cooperative agreement resulted from Equity's submittal March 23, 1976, of a proposal in response to DOE's Program Opportunity Notice No. 2. That proposal described a process proprietary to Equity Oil Company for in situ treatment of a water-impregnated, naturally leached and permeable zone of oil shale. The project was officially designated as Cooperative Agreement No. DE-FC20-78LC10747 between the U.S. Department of Energy (DOE) and Equity Oil Company for the BX In Situ Oil Shale Project. It became effective March 1, 1977, and its duration is estimated to be 55 months. Field tests of the BX In Situ Oil Shale Project commenced in September 1979 and will be conducted over a period of approximately two years. During that time, some 1,000 billion Btu's of heat will be injected into the leached zone as superheated steam. If the process can be perfected to the point of technical, economic, and environmental viability, the key will have been found to the recovery of millions of barrels of shale oil from a section of the Green River formation heretofore unavailable as an energy resource by any other recovery technology. Moreover, this recovery will have been made possible using equipment which for the most part is readily available from conventional oil field stocks. As of December 31, 1980, Tasks No. 1 and No. 2 had been completed and Tasks No. 3 and No. 4 are in progress. During the period September 18, 1978 to December 31, 1980, a total of 549,993 barrels of water as steam were injected into project wells at an average wellhead temperature of 552F and an average wellhead pressure of 1360 psig. Mechanical problems with steam generation equipment have resulted in the injection procedure at rates and temperatures below design; however, they were substantially resolved in October 1979. Evidence of leached zone heating has been observed in all production wells and in project temperature observation wells. In October 1980, the first oil was produced from the project wells. The initials "BX" derive from the project's location on Equity-interest Boies fee acreage and from its experimental character. The fee land, consisting of 1,000 acres, is owned by Equity (50%) and Atlantic Richfield (50%). The interests are undivided and each company has right of access to and use of the property.

PROJECT/PROCESS DESCRIPTION

The project is based on one basic premise: in the central portion of the Piceance Creek Basin of Northwestern Colorado, a section of oil shale-bearing rocks in the Parachute Creek member of the Green River Formation, commonly referred to as the leached zone, contains very large reserves of oil in place as oil shale. This section, or leached zone, has enough permeability and porosity to permit in situ retorting of the oil shale contained therein without resorting to mining and/or other fracturing techniques to create permeability and porosity before retorting. The project's purpose is to demonstrate the technical feasibility of using superheated steam at 1,000F and 1,500 pounds pressure psi as a heat-carrying medium to retort in situ oil shale of the leached zone, thus providing a mechanism for oil recovery with minimum environmental impacts. Specifically, the project involves retorting the oil shale by injecting superheated steam into the leached zone through an array of injection wells, and recovering the steam, water, oil, and gas produced from the leached zone through an array of production wells. During a two-year course of field tests, it is intended that approximately 1,000 billion Btu's of heat will be injected as superheated steam into a leached zone about 540 feet thick, covering seven-tenths of one acre, and containing an estimated 636,000 barrels of oil in place as oil shale. Project field tests commenced June 14, 1979. Project success will be measured by the degree to which (1) the injection goals can be met, (2) the target amount of oil shale can be raised to the retorting temperature, and (3) a reasonable percentage of the retorted oil is recovered. The project's field test program borders Black Sulphur Creek at a point 35 miles southwest of Meeker, in the east half, southeast quarter, Section 6, Township 3 south, Range 96 west, Rio Blanco County, Colorado. Under terms of its cooperative agreement with the government, Equity, as operator of the project, agreed to perform four basic tasks:

- Leached zone site evaluation
- Laboratory experimentation
- Field tests
- Environmental research.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

Not Available

(Map Not Available)

(Map Not Available)

PLANT TYPE**MANAGEMENT AND FINANCE**

Product: Shale oil

Production: 60,000 BPD

Input Material: 80,000 TPD of 30 GPT shale; 8,500 AF/yr of water

Process: Room-and-pillar mine, surface retort

Location: Piceance Basin, Rio Blanco County

Current Status: Planning studies underway. Land exchange requested.

Sponsor: Exxon Co., U.S.A.

Contractor: Not Selected

Manager: J. P. Racz

Phone: (713) 656-6341

Location: P.O. Box 2180, Houston, Texas 77001

Key Contact: J. P. Racz

Funds Expended: \$4 million

Total Estimated Capital Required: \$2-3 billion (1980 dollars)

Financing Plan: 100 percent equity

MAJOR PERMIT ACTIONS/DECISIONS

In December 1979, Exxon applied for an exchange of 11,814 fee acres for 10,840 acres of BLM land. BLM denied the land exchange request in 1980. Approval of this land exchange will result in consolidation of Exxon's scattered fee lands for an economic block of minable resources. It also will contribute significantly to increased federal control of the central Piceance Basin and allow BLM to consolidate additional mineable blocks. Exxons own senior water rights on the White River and an application for a right-of-way permit to inundate 40 acres of federal land in conjunction with development of the required water system has also been made.

PRODUCT MARKETS

Product will be shale oil suitable for further processing in a refinery.

ENVIRONMENTAL IMPACTS

Data gathering for an environmental baseline program began in the spring of 1980, in cooperation with federal and state authorities.

SOCIOECONOMIC IMPACTS

About 2,000 permanent employees are anticipated at the proposed level of production, with a peak construction employment of 4,000. A study of community requirements for plant employees and support infrastructure is being planned.

PROJECT HISTORY AND STATUS

Starting in 1961, Exxon acquired mineral rights ownership of about 11,800 acres of land in the Piceance Basin. During 1963 to 1967, Exxon participated in the Bureau of Mines GC retort work at Anvil Points and in the Paraho Demonstration Program from 1974 to 1976. Shale oil upgrading was investigated from 1963 to 1967. Exxon also has investigated catalytic cracking of the upgraded shale oil and jet fuel producibility from shale oil in 1974 to 1977 for the Department of Defense.

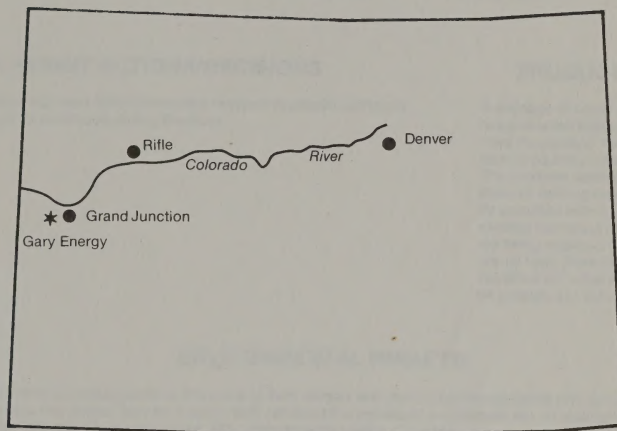
PROJECT/PROCESS DESCRIPTION

The Exxon project will utilize underground room-and-pillar mining with surface retorting to produce shale oil suitable for processing in existing refineries. The underground mine will be capable of producing 80,000 TPD of raw oil shale for a 30-year period. Surface retorting facilities will be capable of producing 60,000 BPD of shale oil. Processed shale will be disposed of in gulches on the site. A water system consisting of diversion from the White River, a delivery pipeline, a reservoir at the confluence of 13-Mile and 14-Mile Creeks, and a supply pipeline to the plant will be developed. Other facilities include a product pipeline for the shale oil product, ammonia and sulfur storage and loading facilities near Rifle, two 230 kv power transmission lines, and an access road from the Piceance Creek Road to the plant site.

Exxon

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

[illegible]



COLORADO

PLANT TYPE

Product: Transportation Fuels

Production: 10,000+ BPD liquid products

Input Material: 10,000 BPD raw shale oil

Process: Hydrotreating/
Hydrocracking

Location: Gary Refining Company,
Fruita, Colorado

Current Status: Feasibility Study grant
awarded.

MANAGEMENT AND FINANCE

Sponsor: Gary Energy Company (A Gary Refining Company
Subsidiary)

Contractor: UOP Process Division, UOP Incorporated, The Ralph M.
Parsons Company, Environmental Research &
Technology, Incorporated

Manager: Stanley B. Weil, Vice President, Refining

Phone: (303) 858-9811

Location: Gary Community Rural Station, Fruita, Colorado 81521

Key Contact: George Gerson, Manager, Economics & Process
Services

Funds Expended: Not available

**Total Estimated
Capital Required:** To be determined during Feasibility Study

Financing Plan: Not determined

MAJOR PERMIT ACTIONS/DECISIONS

Permit applications have not been filed. Information required to prepare pertinent permit applications will be developed during the study.

PRODUCT MARKETS

A shortage of crude oil in the refinery area has prevented expansion of the refinery to meet the existing market for refined petroleum products in Mesa and nearby counties. The products derived from the proposed shale oil refining facility can therefore be easily absorbed within the boundaries of Gary's existing marketing network, and new markets are being explored for military and commercial jet fuels. Potential markets have been identified for sulfur and ammonia, which will be produced in the new facilities.

ENVIRONMENTAL IMPACTS

With the project being located on and adjacent to the existing Gary refinery site, many factors associated with site evaluation and impacts are inherently less critical to this project than for a grass roots refinery on a previously undisturbed site. In addition:

- The current refining operation is in compliance with environmental laws and regulations.
- The project involves commercially available technology having well-defined emission characteristics. No novel or unproven effluent control measures are required.

SOCIOECONOMIC IMPACTS

The existing refinery site is approximately 15 miles from Grand Junction, Colorado, the center of a population area in excess of 60,000 people. With a projected 300 to 400 labor force during construction and an additional 60 to 70 during plant operations, an impact on the surrounding communities is not expected.

PROJECT HISTORY AND STATUS

The Gary refinery was constructed in 1957 by American Gilsonite Company to process gilsonite, a solid hydrocarbon ore from Northeast Utah. Gary Energy acquired the installation in 1973 after American Gilsonite discontinued refining gilsonite ore. Processing gilsonite into refined products was a forerunner of the synthetic fuels industry. Gilsonite has a very high nitrogen content. The problems associated with processing gilsonite ore are similar to those associated with shale oil.

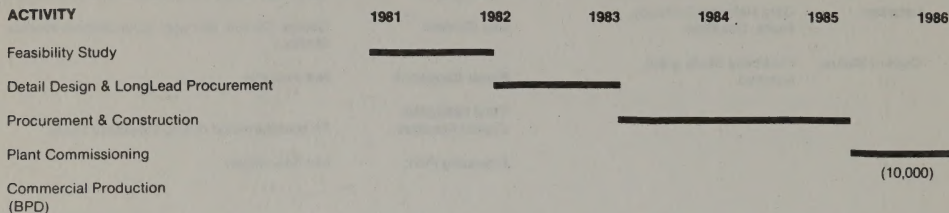
Two substantial shale oil refining programs have been conducted at this site. In 1961, the facility was engaged by Union Oil Company to process over 13,000 barrels of crude shale oil product from the Union "A" retort semi-works project in the Piceance Basin. In 1975, 9,956 barrels of crude shale oil were refined from the Paraho oil shale retort at Anvil Points, Colorado into military fuels for the Navy. The refining experiments on Union and Paraho synthetic crudes provided experience in shale oil refining. They also established the Gary Refining Company as the first commercial refinery to process significant quantities of Green River shale oil. An existing common carrier pipeline, dedicated for crude oil delivery to Gary's refinery, runs adjacent to proposed shale oil producing areas. This pipeline could carry 10,000 BPD of shale oil to the refinery.

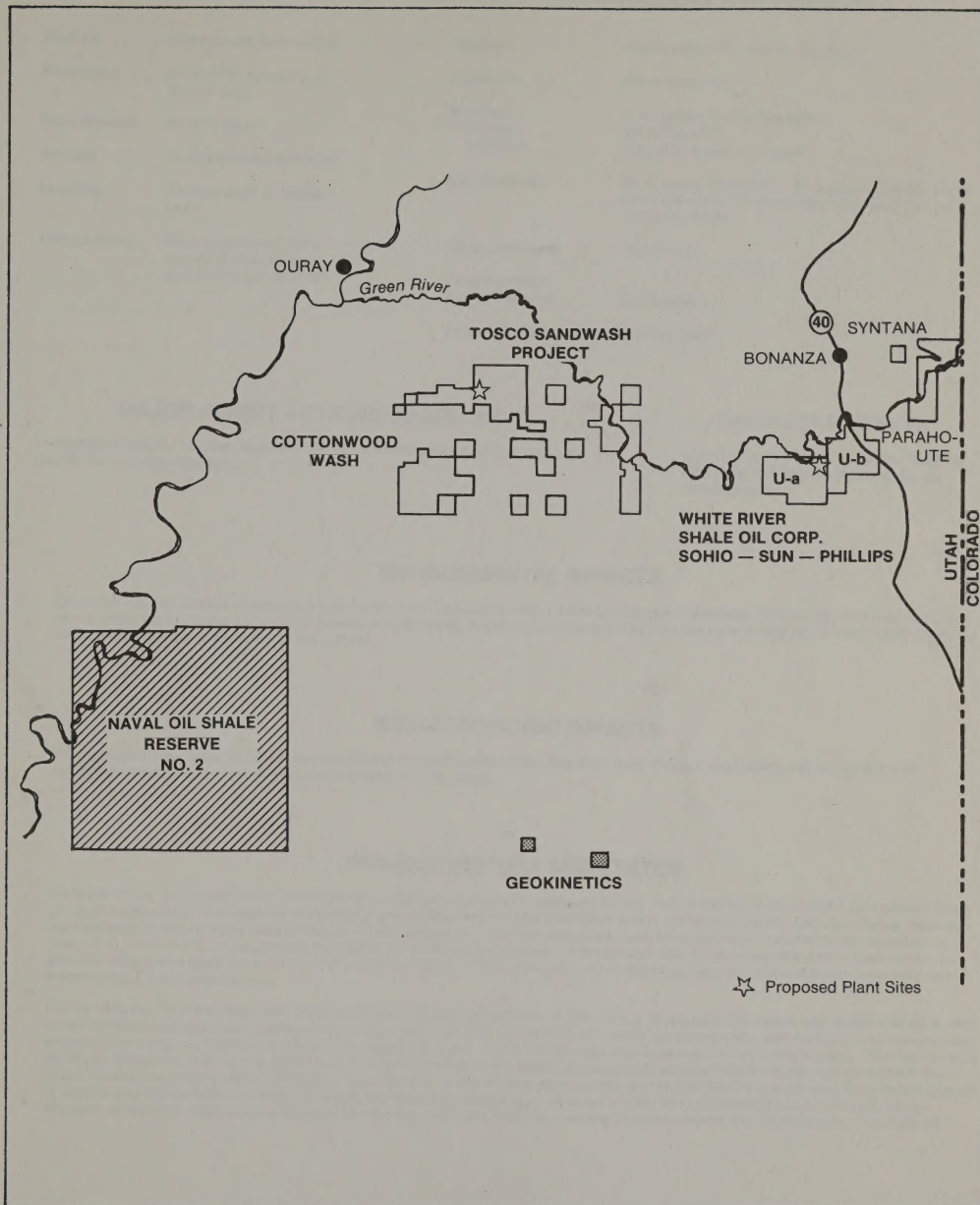
In 1980 Gary Energy Company submitted a proposal to the Department of Energy to conduct a feasibility study for upgrading 10,000 BPD of raw shale oil into transportation fuels. The upgrading facilities would be installed at the Gary Refining site in Fruita, Colorado near the Colorado-Utah shale oil reserves. Gary was awarded the requested grant to conduct the study. Final grant negotiations between Gary, its contractors, and DOE have been completed. The study is expected to begin in 1981. The feasibility study is projected for completion in 15 months. An additional 42 months will be required for engineering, construction, and start-up of the new facilities.

PROJECT/PROCESS DESCRIPTION

The proposed facilities will refine shale oil into high-quality transportation fuels using proven technologies. Since the quality of the feedstock varies with the source and retorting method, the scheme must allow for processing a wide range of shale oils. The chosen method is hydro-treating followed by hydrocracking. The hydroprocessing/hydrocracking technology has been demonstrated on petroleum-derived feeds in many commercial units operating throughout the world. Pilot plant testing using shale oil has been performed to develop modifications to petroleum-derived predictive correlations.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES





UTAH

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil and low-Btu gas	Sponsor:	Geokinetics, Inc., with DOE support
Production:	2,000 BPD for each production unit	Contractor:	Geokinetics, Inc.
Input Material:	20 GPT shale	Manager:	J. M. Lekas, Project Manager
Process:	Horizontal modified in situ	Phone:	(801) 353-4747
Location:	70 miles south of Vernal, Utah	Location:	Box 889, Vernal, Utah 84078
Current Status:	Pilot operations; 15,000 barrels of shale oil produced through 12/31/80	Key Contacts:	M. A. Lekas, President, J. D. Downen, Vice-President (415) 676-4462, 280 Buchanan Field Road, Concord, California 94520
		Funds Expended:	\$9.0 million
		Total Estimated Capital Required:	Not Available
		Financing Plan:	Not Available

MAJOR PERMIT ACTIONS/DECISIONS

Collection of data for permits began in 1977. Work is underway to secure necessary permits for full-scale operation.

PRODUCT MARKETS

Shale oil has been sold to Plateau Refining Company and Western Refining Co. for blending tests.

ENVIRONMENTAL IMPACTS

Environmental assessment reports have been prepared in connection with a DOE Cooperative Agreement. The primary environmental concern is expected to involve combustion gases from the retorts. Additional concerns will include the need to dispose of waste water produced with the oil, and also revegetation of the surface.

SOCIOECONOMIC IMPACTS

The operation is expected to have a minimal impact on local communities. The work force for each production unit will be about 60 employees, most of whom will live on site in a mobile home village.

PROJECT HISTORY AND STATUS

Geokinetics, Inc. was organized in April 1969, as a minerals development company. In July 1972 Geokinetics organized a joint venture with a group of independent oil companies to develop in situ methods of shale oil extraction, and to acquire and develop oil shale leases. Work on the horizontal modified in situ process began in 1972. Design and cost estimates were made for a horizontal modified in situ operation on Tracts C-b, U-a and U-b, in preparation for bidding on the Prototype Federal Oil Shale lease sale. Small-scale pilot tests in steel retorts, to simulate a horizontal basis, were carried out in 1974 and early 1975. In April 1975 in situ field tests began in Kamp Kerogen, and have continued without interruption to date.

During 1975 and 1976 the basic parameters of the process were established. In late 1976, a cooperative agreement was signed with DOE, with whose assistance progress was greatly accelerated. In 1977 and 1978 the process was scaled up substantially, and rock breaking designs were improved and tested. In 1979 larger retorts were tested, up to one-quarter of full scale, and tests began to optimize recovery. The first full-sized retort was blasted in 1979. During 1980 a second full-sized retort was blasted, and equipment was installed for ignition of the first full-sized retort. Twenty-four experimental retorts have been blasted, 14 retorts have been burned, and 15,000 bbls of oil produced. Geokinetics expects to complete its R&D program in 1982, and begin immediately to design and construct a 2,000 BPD commercial production unit. Thirty-thousand acres of oil shale leases were acquired between 1975 and 1980, representing in-place reserves of 1.7 billion barrels of shale oil.

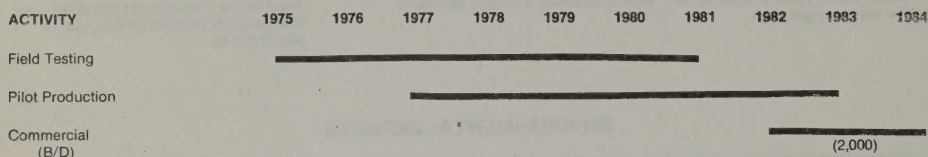
PROJECT/PROCESS DESCRIPTION

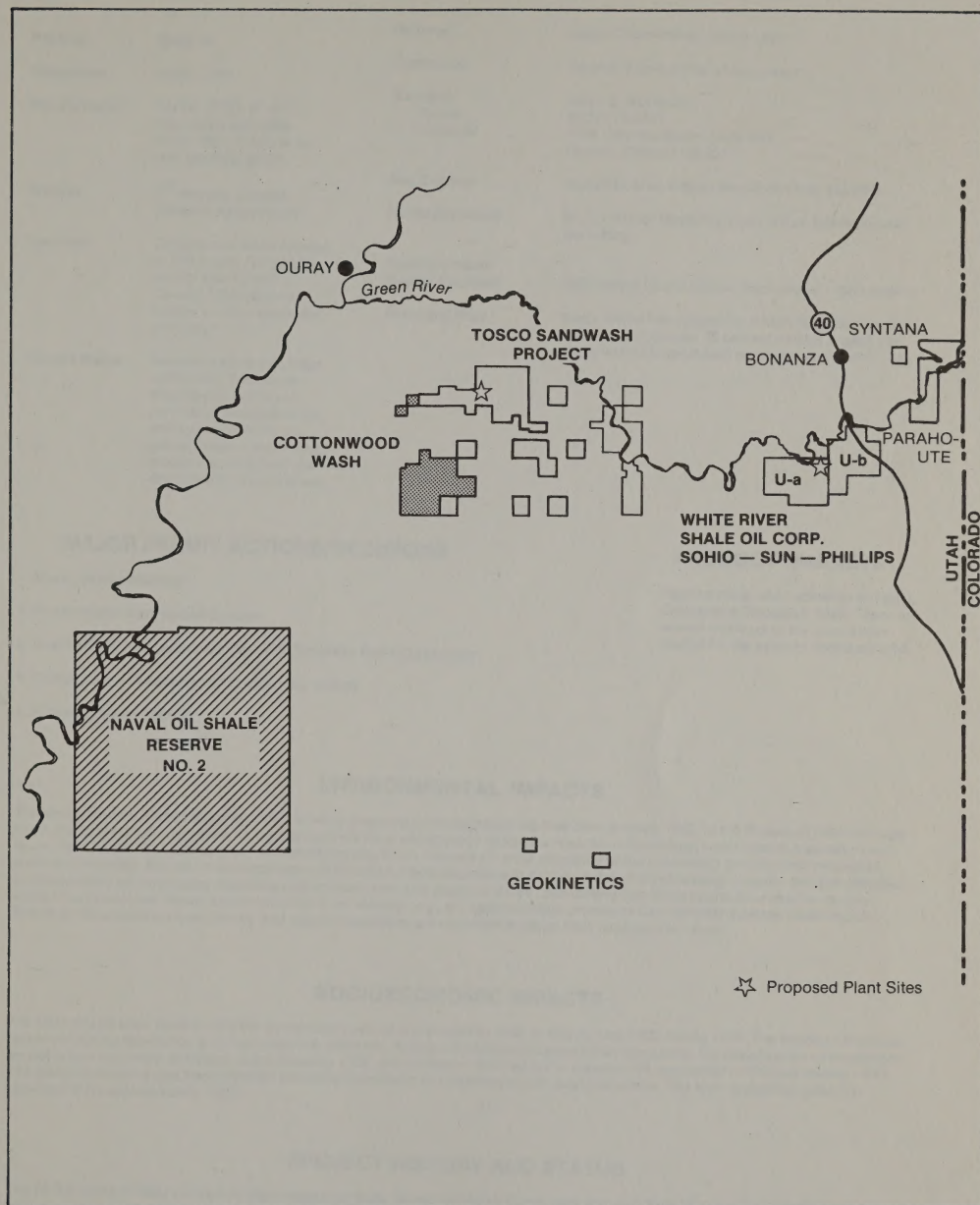
Geokinetics is developing the horizontal in situ retort, using explosive fracturing of the oil shale. There are three basic applications of the process:

1. The LOFRECO process, where blast holes are drilled from the surface to fracture the oil shale bed
2. Horizontal modified in situ, where part of the bed is mined out to provide expansion space for the broken rock
3. Secondary recovery after room-and-pillar mining. After mining is completed, the pillars, roof and floor are blasted to create a large volume of rubbleized rock that is retorted using the horizontal in situ process.

In the LOFRECO Process, a pattern of blast holes is drilled from the surface through the overburden and into the oil shale bed. The explosion produces an upward movement of the overburden and fragments the oil shale. The bottom of the retort is sloped to provide for drainage of the oil to the production wells. Air injection holes are drilled at one end of the retort, and gas exhaust holes are drilled at the other end. The oil shale is ignited at the air injection holes, and air is injected to establish and maintain a burning front. The front is moved in a horizontal direction through the fragmented shale toward the gas exhaust holes at the far end of the retort. The burning front heats the oil shale ahead of the front, driving out the oil, which drains to the bottom of the retort, and flows along the sloping bottom to a sump, where it is lifted to the surface by conventional oil field pumps. As the burning front moves from the air injection to the gas exhaust holes, it burns residual coke in the retorted shale as fuel, and produces a large volume of low BTU combustible gas.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES





UTAH

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil	Sponsor:	Magic Circle Energy Corporation
Production:	30,000 BPD	Contractor:	Science Applications, Incorporated
Input Material:	70,000 TPSD, 27 GPT from room-and-pillar mine, 1500 ft. below surface (surface retort).	Manager:	Harry E. McCarthy (303) 279-0701
		Phone:	1726 Cole Boulevard, Suite 350
		Location:	Golden, Colorado 80401
Process:	T ³ retorting process. (Science Applications)	Key Contact:	Robert G. Hall, Project President, (405) 843-6654
Location:	Cottonwood Wash located in T10 South, Ranges 21 and 22 East Uintah County, Utah (approximately 11 miles southeast of Ouray)	Funds Expended:	\$1,121,000 for feasibility study, initial field work, and permitting
Current Status:	Feasibility study has been completed. Preliminary engineering, full-scale permitting, environmental and socioeconomic programs, product marketing, project financing and risk assessments are underway.	Total Estimated Capital Required:	\$900 million (Commercial development - 1980 dollars)
		Financing Plan:	Magic Circle has applied for a loan guarantee for \$1.45 billion, not to exceed 75 percent of total project cost, and a limited time-phased purchase agreement.

MAJOR PERMIT ACTIONS/DECISIONS

- Major permits obtained
- Project viable from feasibility study
- Availability of loan guarantee from U.S. Synthetic Fuels Corporation
- Completion of Feasibility and Engineering Design
- Raising of equity capital

PRODUCT MARKETS

Pipeline shale oil to refineries in Fruita, Colorado or Roosevelt, Utah. There are several pipelines in the area, and a market for the product seems assured.

ENVIRONMENTAL IMPACTS

The environmental impact statement draft is being prepared to be submitted no later than January 1982, to the Bureau of Land Management. Preliminary indications are that the project will have negligible to moderate impacts on hydrology, water quality, vegetation, and fauna. Special attention will be given to minimizing short-term impacts on local air quality of the processing complex and processed shale embankment. Effects on local geology will include surface alterations to accommodate the processing complex, surface alteration by the addition of a processed shale disposal embankment and catchment dam, and cutting and filling to create or improve access roads. The project will create visual intrusions in an isolated area, but careful design processes can minimize adverse visual impacts. Effects of the project on local climate and aquatic organisms are expected to range from negligible to minor.

SOCIOECONOMIC IMPACTS

The total on-site work force during the construction period is expected to peak at slightly over 2600 during 1984. The breakout of on-site personnel during this period is not yet available. However, during full commercial production operations, the classification of on-site personnel is approximately as follows: administration - 220; maintenance - 480; technical support - 60; production - 700; and mining - 440. The plans for housing and transportation are being formulated in cooperation with local authorities. The total population growth is expected to be approximately 7200.

PROJECT HISTORY AND STATUS

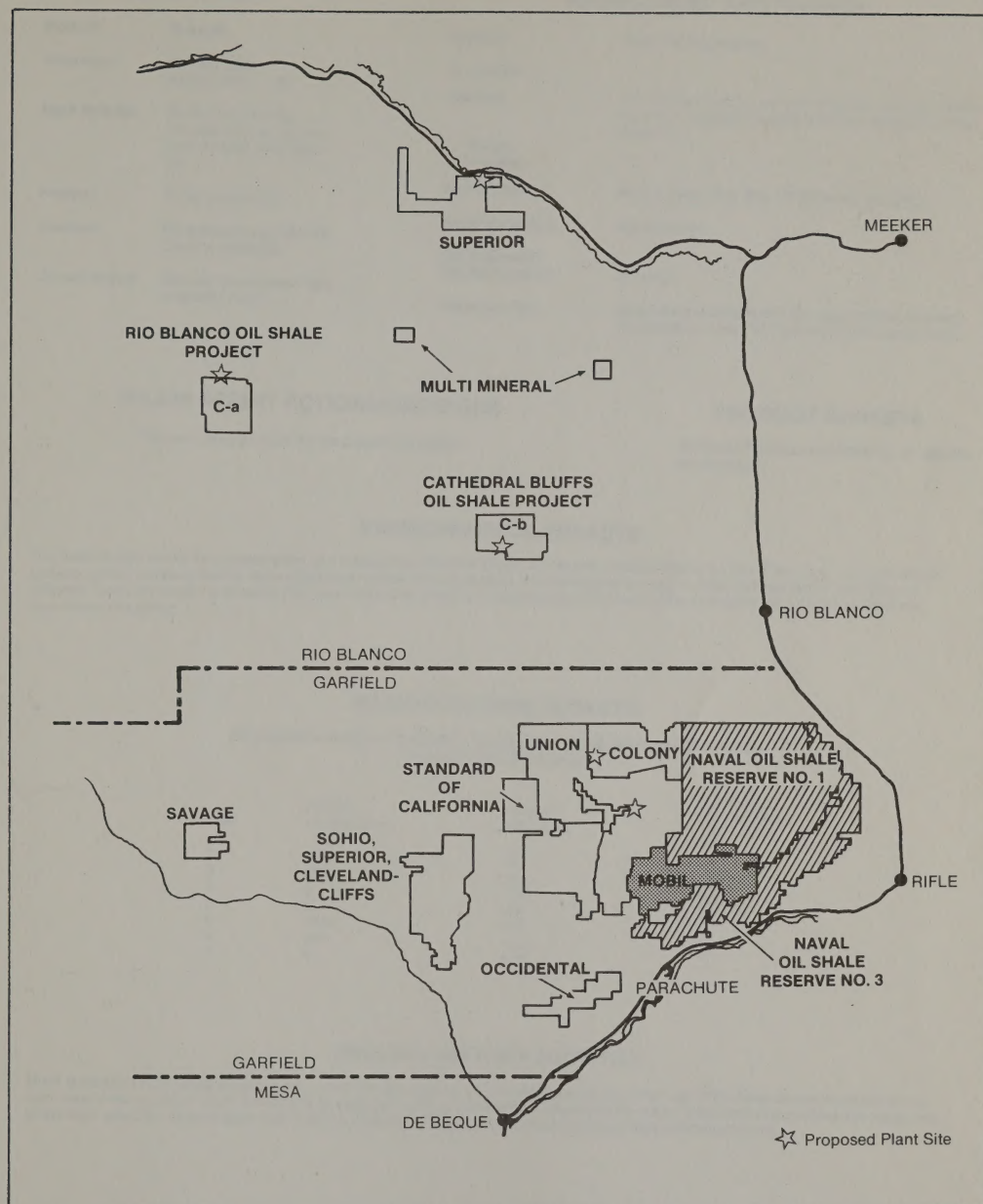
The 76,000 acres of State of Utah oil shale leases currently owned by Magic Circle were acquired from Western Oil Shale Corporation through a stock exchange in July 1980. A segment of continuous lands equal in size to the federal lease site is available on the 5,090-acre Cottonwood Wash Properties which will be developed here, the remaining leases are non continuous sections currently being evaluated for exchange purposes to provide for additional commercial properties. In December 1980, Magic Circle Management decided to initiate a project to explore development of the Cottonwood Wash Properties. At that time, Magic Circle contracted with Science Applications, to perform feasibility studies, initiate permit applications, and perform initial coring for better resource definition, mine design, and environmental evaluations. E. F. Hutton also has been selected to initiate development of project financing for a commercial project at Cottonwood Wash. With this team, Magic Circle is committed to going ahead with development, subject to obtaining the necessary financing, and to a continued favorable economic outlook for the project.

PROJECT/PROCESS DESCRIPTION

Cottonwood Wash is a 5,090-acre tract (of the total 76,000 acres leased by Magic Circle) in the heart of the Uinta Basin in Utah, located in TWP 10 South, Range 21 East (SLM). The estimated oil in place, averaged over the 15 GPT and 25 GPT shales, is 2.1 billion barrels at depths between 1,500 and 2,000 feet. Estimates of recoverable oil using surface processing is at least 200 million barrels. If Modified In Situ (MIS) technology were commercially available, recovery is estimated to be as high as 500 million barrels. At this time, commercial production is planned at 30,000 BPD using surface processing. System design, however, will be carried out to provide maximum potential for the future use of MIS, should it become a commercial technology. The surface processing technology initially selected for the project is based on the Moroccan T³ process, selected because of its minimal risk in scaling to a commercial operation. Innovative T³ design features, compared to previous technology, are lowest water consumption, improved safety, sensible heat recovery, increased process yield, efficiency, flexibility, and continuous process operations. Waste disposal is currently planned to be accomplished on 1,200 acres of the tract. However, an effort is underway to obtain additional properties through exchange or leasing mechanisms to provide for potential future project expansion. Water rights applications have been made for water from the Green River. There are also two aquifers on the site, one at approximately 100 ft. depth, and the Bird's Nest aquifer, at a depth of 850 ft. If necessary, these can provide additional water to the project.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

- I. Feasibility Study (completed)
- II. Construction
 - Start up: January 1983
 - Completion: October 1986 (Process Module No. 1)
- III. Initial Production
 - Start up: October 1986 (Process Module No. 1)
- IV. Full Scale Production
 - Start up: February 1988 (Process Module No. 4)



COLORADO

PLANT TYPE

Product: Shale oil

Production: 50,000 - 1990,
100,000 BPD - 1996

Input Material: 30-35 GPT oil shale
(150,000 TPD would produce 100,000 BPD shale oil)

Process: To be determined

Location: Parachute block, Garfield County, Colorado

Current Status: Concept development and feasibility study

MANAGEMENT AND FINANCE

Sponsor: Mobil Oil Corporation

Contractor:

Manager: J.F. Trauttschold, Jr., General Manager, Synfuels Division and W.H. Marshall, General Manager, Mining and Coal Division

Phone:

Location:

Key Contact: P. C. Fuselier, P.O. Box 1772, Denver, CO 80217

Funds Expended: Not Available

Total Estimated Capital Required: \$4 billion

Financing Plan: Both loan guarantees and price guarantees are being requested from the U.S. Synthetic Fuels Corporation.

MAJOR PERMIT ACTIONS/DECISIONS

The permitting process for the project has begun.

PRODUCT MARKETS

Product will be pipelineable shale oil suitable for refining.

ENVIRONMENTAL IMPACTS

The water supply would be a combination of a reservoir on Main Elk Creek, a diversion intake on the Colorado River near Parachute, and a delivery system involving several miles of above-or-below ground pipeline. It is anticipated that spent shale disposal would take place in Wheeler Gulch. Air quality monitoring has been conducted at the proposed site since the fall of 1980 and additional baseline studies will commence this spring.

SOCIOECONOMIC IMPACTS

Oil Shale Mine & Retort 12,500 BPD Test Module - 50,000 BPD Commercial Scale
Tentative Direct Employment

Year	Facility Construction	Facility Operation	Main Elk Construction Operation
1	600	50	0
2	600	417	75
3	0	417	75
4	0	417	75
5	1800	417	4
6	200	915	4
7	0	915	4

PROJECT HISTORY & STATUS

Mobil is considering oil shale development on the Parachute Block in Garfield County prior to the year 2000. Most development will be on lands held in fee by Mobil. Work currently is in a stage of concept development and feasibility study. Movement of personnel and equipment to the mine would be via an access road from the Parachute Creek Valley to the mine at the head of Wheeler Gulch.

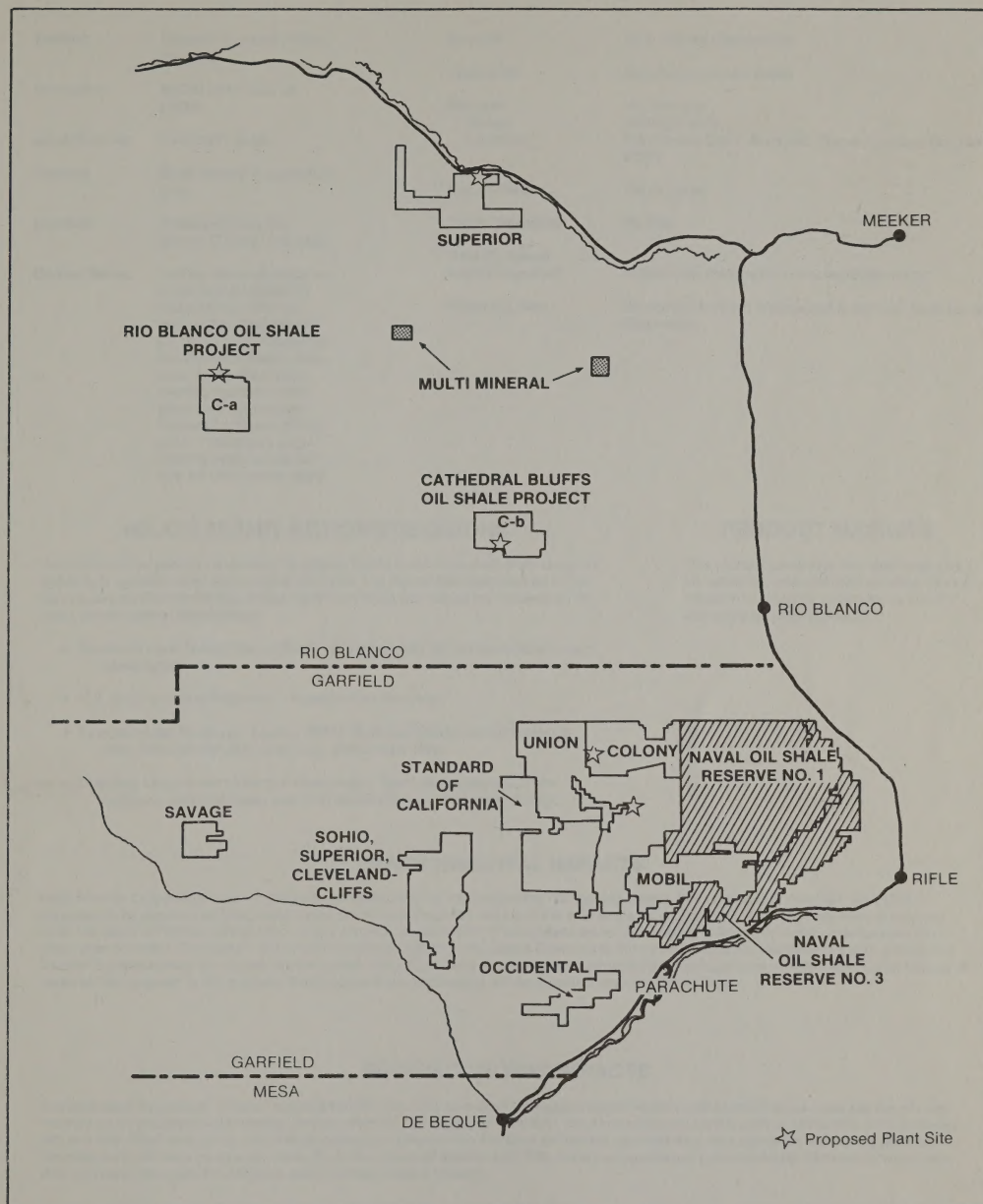
PROJECT/PROCESS DESCRIPTION

Mobil will utilize underground room-and-pillar mining and surface retorting. The precise location of surface retorting facilities is not yet certain; however, they probably would be located on either the Parachute Block or the Mahaffey properties, the smaller parcel south of the Parachute Block. The type of retorting technology is still under review. The ultimate capacity of the facilities may be 100,000 BPD, however, development to this level probably would be phased. A 12,500 BPD module would be built first, then a 50,000 BPD facility; and ultimately a 100,000 BPD facility may be developed if economics remain favorable. It may be possible to have operational 50,000 BPD facility by 1990, and 100,000 BPD facility by 1996. Primary crushing will take place underground with the raw shale being moved to the surface retorting facilities by conveyor. Secondary oil recovery through modified in situ methods also may be possible at a later date. Secondary crushing of raw shale would take place on the surface. Spent shale will be moved by conveyor. Raw fines will be compacted at the head of a surface drainage for potential future retorting. Spent shale will be compacted into terraces in Wheeler Gulch. Catchment basins would be installed at each disposal pile to capture surface runoff and seepage.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

Construction start 1984-1985

Production from the first retort 1986-1987



COLORADO

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil and associated minerals	Sponsor:	Multi Mineral Corporation
Production:	50,000 BPD shale oil (1989)	Contractor:	Multi Mineral Corporation
Input Material:	30-35 GPT shale	Manager:	Hal Aronson
Process:	Multi Mineral Integrated In Situ	Phone:	(303) 243-9406
Location:	Piceance Basin, Rio Blanco County, Colorado	Location:	715 Horizon Drive, Suite 380, Grand Junction, Colorado 81501
Current Status:	Mining Research Program underway at USBM Oil Shale Mining Environmental Research Facility on Horse Draw located in the Piceance Basin, Colorado. Preliminary engineering plans are complete for a subsequent Processing Research Program. Preliminary engineering plans are underway for commercial plant.	Key Contact:	Hal Aronson
		Funds Expended:	No data
		Total Estimated Capital Required:	Project cost is expected to exceed \$500 million.
		Financing Plan:	Source of financing is proposed to be from Multi Mineral Corporation.

MAJOR PERMIT ACTIONS/DECISIONS

Multi Mineral Corporation is seeking to acquire rights to mine oil shale from lands on which they currently hold sodium mineral rights. It is anticipated that such an action may require an Environmental Impact Statement (EIS) that would be followed by the major permit actions listed below:

- Bureau of Land Management (BLM) - A right-of-way for products pipeline and power lines
- U.S. Army Corps of Engineers - Pipeline river crossings
- Environmental Protection Agency (EPA) - Spill prevention countermeasure plan; National Pollution Discharge Elimination Plan
- Colorado Department of Natural Resources - Spent shale disposal; mine approval; wells and water use; land reclamation; air and water quality.

PRODUCT MARKETS

This process generates four products: shale oil, nahcolite, soda ash and alumina. Market research is currently underway to identify end users of these products.

ENVIRONMENTAL IMPACTS

Multi Mineral Corporation has not prepared an assessment of the environmental impacts related to a commercial complex. An EIS is expected to be required on this project because of the anticipated nature of the land acquisition. Approval of such a statement should not pose the major constraint facing other in situ projects: degradation of subsurface water by leaching of spent shale left underground after retort abandonment. The reason is that mining will take place in the Saline Zone where the oil shale beds are relatively dry and unfractured. If water is encountered, the stopes can be sealed using the mining access ways constructed during stope development. No outside source of water will be required in this process. Make-up water for processing will be supplied from the Saline Zone.

SOCIOECONOMIC IMPACTS

It is estimated that a Multi Mineral Integrated In Situ Process operation will require approximately half as many employees per ton of rock retorted as an aboveground retorting process. Applied to a 50,000 BPD facility, this assumption projects a peak construction force between 300 and 400. Total new direct and indirect population influx to the Rio Blanco/Garfield counties area may approach 400 during peak construction and 800 on a permanent basis. Since the towns of Meeker and Rifle are about equidistant (approximately 40 miles) from the site, they probably will share the project's major socioeconomic impacts.

Multi Mineral

PROJECT HISTORY AND STATUS

In November 1978 the Multi Mineral Corporation submitted an unsolicited proposal to the Department of Energy and the U.S. Bureau of Mines (Department of Interior) to jointly enter into a program which would involve constructing and testing a full-scale, minimum-size oil shale plant using the Multi Mineral Integrated In Situ Process. A possible site is the 2,400-acre U.S. Bureau of Mines Oil Shale Tract on Horse Draw in the Piceance Creek Basin.

The proposed program has two phases — the first involves conducting a pilot mining program in the Saline Zone, the second, sinking a larger diameter shaft and testing the Integrated In Situ Process at full module size. As proposed, the program would take approximately five years to complete, after which the Multi Mineral Corporation would bring the tract to commercial-size development under normal lease terms. The federal government would acquire the use of all technical data on which the process is based. All new technology developed during the test program is proposed to be owned jointly by the federal government and Multi Mineral Corporation. Data obtained during commercial development also would be available to the federal government for use in planning the total resource development. Multi Mineral Corporation currently is conducting a 24 month mining research program at this site utilizing the existing 8'-diameter shaft. This program will provide geotechnical data to determine mining feasibility and bulk samples of the nahcolite/dawsonite oil shale horizons to provide material for process plant engineering. Since the proposed joint program with DOE and DOI was never approved, Multi Mineral Corporation has been seeking alternative courses of action that would allow this project to proceed.

PROJECT/PROCESS DESCRIPTION

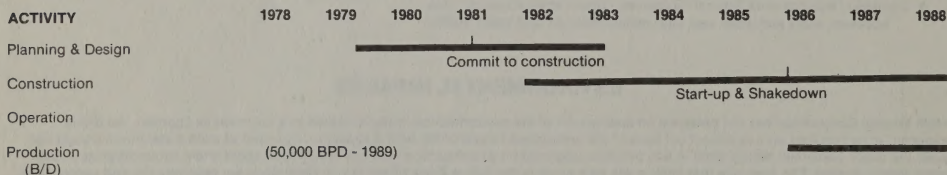
The Multi-Mineral Integrated In Situ Process for the recovery of shale oil and associated minerals consists of three steps: (1) underground mining and nahcolite recovery; (2) retorting and hydrocarbon recovery; and (3) leaching and soda ash/alumina recovery.

Mining — The process involves creating large underground chambers (stopes) by sequential blasting and removal of oil shale from the stope. Gravity flow extraction is through funnel-like openings at the base. The stopes are separated by walls of unbroken oil shale. Their dimensions are variable, depending on the rock character and zone thickness. Extracted oil shale is crushed and screened into two sizes with the larger size being backfilled into the stope. The smaller size is then crushed and screened to separate nahcolite from the oil shale. Rejects from this operation are stored on the surface for future processing.

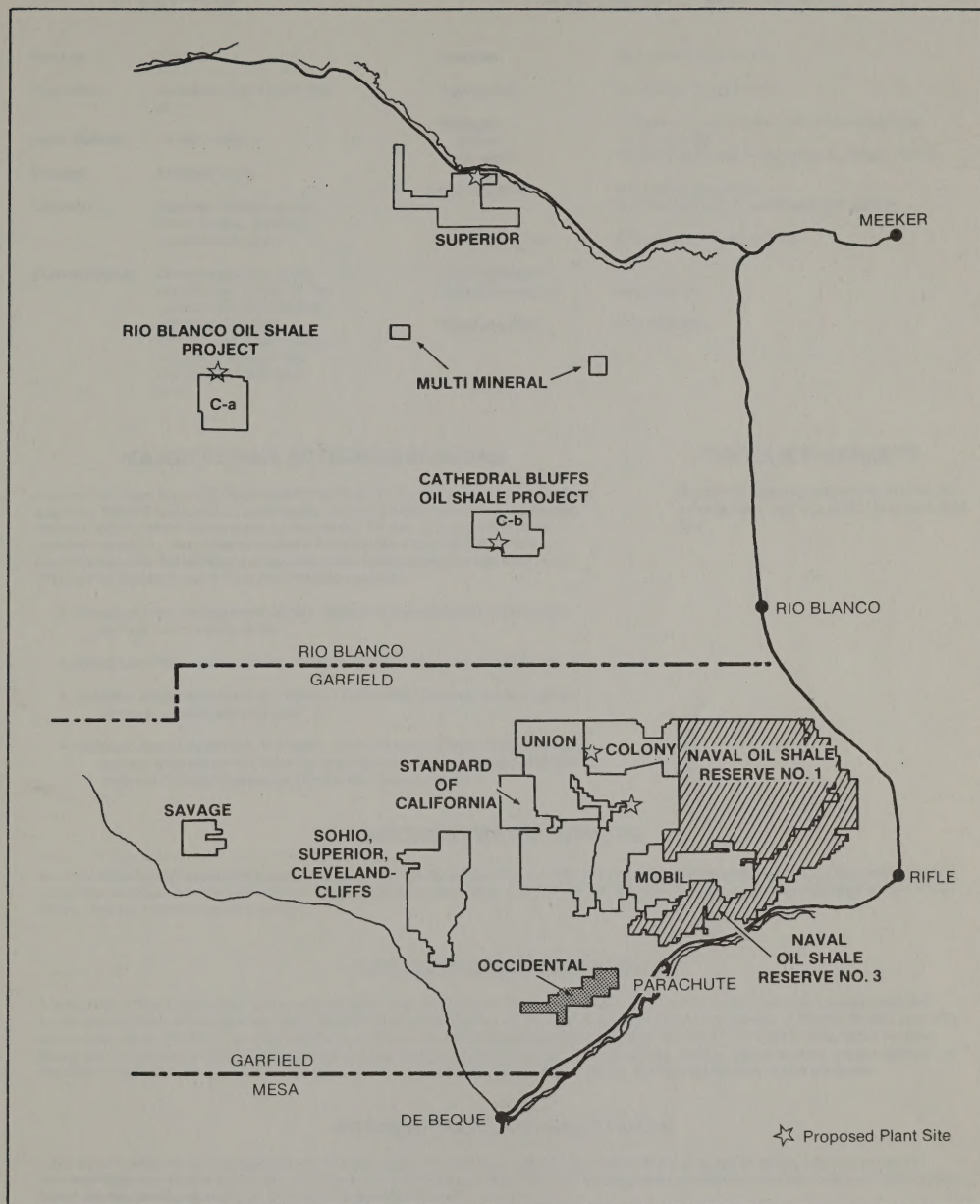
Retorting — After backfilling with the top size, the stopes, full of sized oil shale, become underground retorts. The oil shale is retorted by hot gas introduced into the top of the retort and extracted at the base. The shale oil, formed along with the pyrolysis gas and water, is directed to a collection sump where the oil, water and gas are separated. The oil is pumped to the surface for marketing. After the oil shale has been retorted, residual carbon is left on the spent shale. The carbon is converted into a low-to-medium Btu gas which will be used for onsite electrical power generation.

Leaching — After shale in the retort is cooled, soda ash and alumina are leached from the stope by spraying water over the top of the retorted shale and collecting this water as pregnant liquor at the base. This can be done in more than one stope simultaneously in a countercurrent process. The pregnant liquor is then pumped to the surface for recovery of the alumina and soda ash.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES



Note: Commercial activities contingent on success of Cooperative Test Program



PLANT TYPE

Product: Shale oil

Production: Not applicable as field test site

Input Material: 15 GPT shale

Process: Modified in situ

Location: Between Parachute and Roan Creeks, Garfield County, Colorado

Current Status: Demonstration of in situ retort began 12/20/75. The seventh commercial size retort was recently rubble and is expected to be retorted with the eighth retort later this year.

MANAGEMENT AND FINANCE

Sponsor: Occidental Oil Shale, Inc.

Contractor: Occidental Oil Shale, Inc.

Manager: R. Nelson, Vice President and General Manager
Phone: (303) 242-8463
Location: P.O. Box 2687, Grand Junction, Colorado 81501

Key Contacts: W. H. Love, Chairman
 W. F. McDermott, Executive Vice President

Funds Expended: \$63 million (through 1/1/79)

Total Estimated Capital Required: Not Available

Financing Plan: Not Available

MAJOR PERMIT ACTIONS/DECISIONS

A permit has been issued to Occidental to increase the size of its waste rock disposal area from 500,000 to 8.8 million cubic yards. Continued development at the present site was contingent on the issuance of this permit. To date, the primary federal approval needed for this project has come from the Mine Environmental Safety Administration for maintaining a subsurface combustion zone. Permits have been obtained for Retorts 7 and 8 from the following agencies:

- Bureau of Land Management (BLM) - Rights-of-way and other matters concerning use of public lands
- Mined Land Reclamation Board - Surface disposition of run-of-mine shale
- Colorado State Department of Health - Air Pollution Control Division - all air emission permits are approved
- Colorado State Department of Health - Water Pollution Control Division - sub-surface disposal permit allowing underground storage of spent shale and a National Pollutant Discharge Elimination System permit.

PRODUCT MARKETS

Occidental has sold shale oil to refiners for refining tests, and to a utility for a boiler fuel test.

ENVIRONMENTAL IMPACTS

Environmental impact assessment reports have been prepared in connection with the DOE cooperative agreement. An environmental statement may be required in the event of a commercial-scale project. Such a statement has not been prepared. The abandonment plan for spent retorts requires further study at this time.

SOCIOECONOMIC IMPACTS

It is estimated that this modified in situ process operation will have an impact on the area. The three counties that may receive socioeconomic impacts from this project are Mesa, Garfield and Rio Blanco counties, Colorado, with present populations of 80,000, 20,000, and 5,000 respectively (total 105,000). The impacts, if any, probably will be felt most significantly in Garfield County. In light of other state developments concurrent with this project in Garfield and Rio Blanco counties, housing and community services will be in short supply during construction phases but with presently ongoing community planning studies, social needs for the new population will be adequate.

PROJECT HISTORY AND STATUS

Occidental Petroleum Corporation entered into an agreement with D.A. Shale, Inc. in mid-1972 and acquired about 4,000 acres of land between Roan and Parachute Creeks, Garfield County, Colorado. The 2,400 shale-bearing acres contain an estimated shale oil reserve of 0.3 billion barrels, averaging about 17 gallons of oil per ton of shale.

Site preparation began in 1972 and construction of the first modified in situ retort, 1E, was completed by December 1972. Retort 1E contained approximately 4,000 tons of broken shale at 25 percent average void volume and was ignited in June 1973. Since then, operations have been underway almost continuously, through a series of progressively larger retorts. Retort 6 has 100 times the volume of the first experimental unit and does not require further scale-up for commercial operations.

The initial three retorts were located off a single horizontal mine opening. Retort 1E was mined in the form of a small room with a vertical cylindrical rise providing the initial void volume. The retort operated successfully, producing over 1,200 barrels of oil. In Retort 2E, the void volume was reduced, the blast pattern modified, and the retort depth increased 22 feet; the retort was fired in March 1974. Retort 3E tested

Occidental

An entirely different retort design which ultimately provided the basis for scale-up to commercial-size units. Retort 3E was ignited in February 1975 and produced 1,600 barrels of oil. Following completion of the first three retorts, operations were transferred to a new large-scale development mine. Retort 4 was the first commercially-sized unit, being 50 times larger than the first retorts. Ignited in 1975, Retort 4 produced some 27,500 barrels of oil, somewhat less than the full potential, with difficulties traced to geologic conditions resulting in inadequate ore rubrization. Geologic conditions were overcome in Retort 5 by design changes. However, the method of rubrization using a vertical "tapered-slot" void, produced an uneven horizontal distribution of porosity resulting in channeling of gas flow. Burned in 1977, Retort 5 produced 10,100 barrels of oil. Retort 6 was a scale-up of the successful Retort 3E design, was half an acre in cross-sectional area, and high as a 30-story building. The 24 percent void volume in the retort was created by mining horizontal rooms to provide more uniform permeability in the rubble zone. Retort 6 was ignited in August 1978, and operating conditions were upset soon after start-up by a partial collapse of the retort roof (sill pillar slumping into the retort). However, corrective actions were taken and 55,700 barrels of oil were produced from this retort, representing 46 percent of the oil in place.

Retorts 7 and 8, currently under construction, will utilize the Retort 6, three-level design, except that they will be operated from the ground surface rather than from a mine level separated from the retort by a sill pillar. Retorts 7 and 8 will be operated simultaneously to study conditions resulting from multi-retort operation.

OCCIDENTAL MODIFIED IN SITU RETORTING EXPERIMENTS

Retort	Year Production	Size (feet)	Oil Produced (barrel)
1E	1973	31 x 31 x 72	1,200
2E	1974	32 x 32 x 94	1,400
3E	1975	32 x 32 x 113	1,600
4	1975	120 x 120 x 271	27,500
5	1977	118 x 118 x 158	10,100
6	1978	162 x 162 x 254	55,700
7	1982	162 x 162 x 243	97,000 (est.)
8	1982	162 x 162 x 242	97,000 (est.)

The D.A. Shale property is at best only marginal for sustained commercial production. Occidental bid unsuccessfully for Prototype Oil Shale Leases C-a and U-a. Occidental has since acquired a major interest in the federal C-b Oil Shale Tract from the original lessees, and has limited commercial plans to that tract.

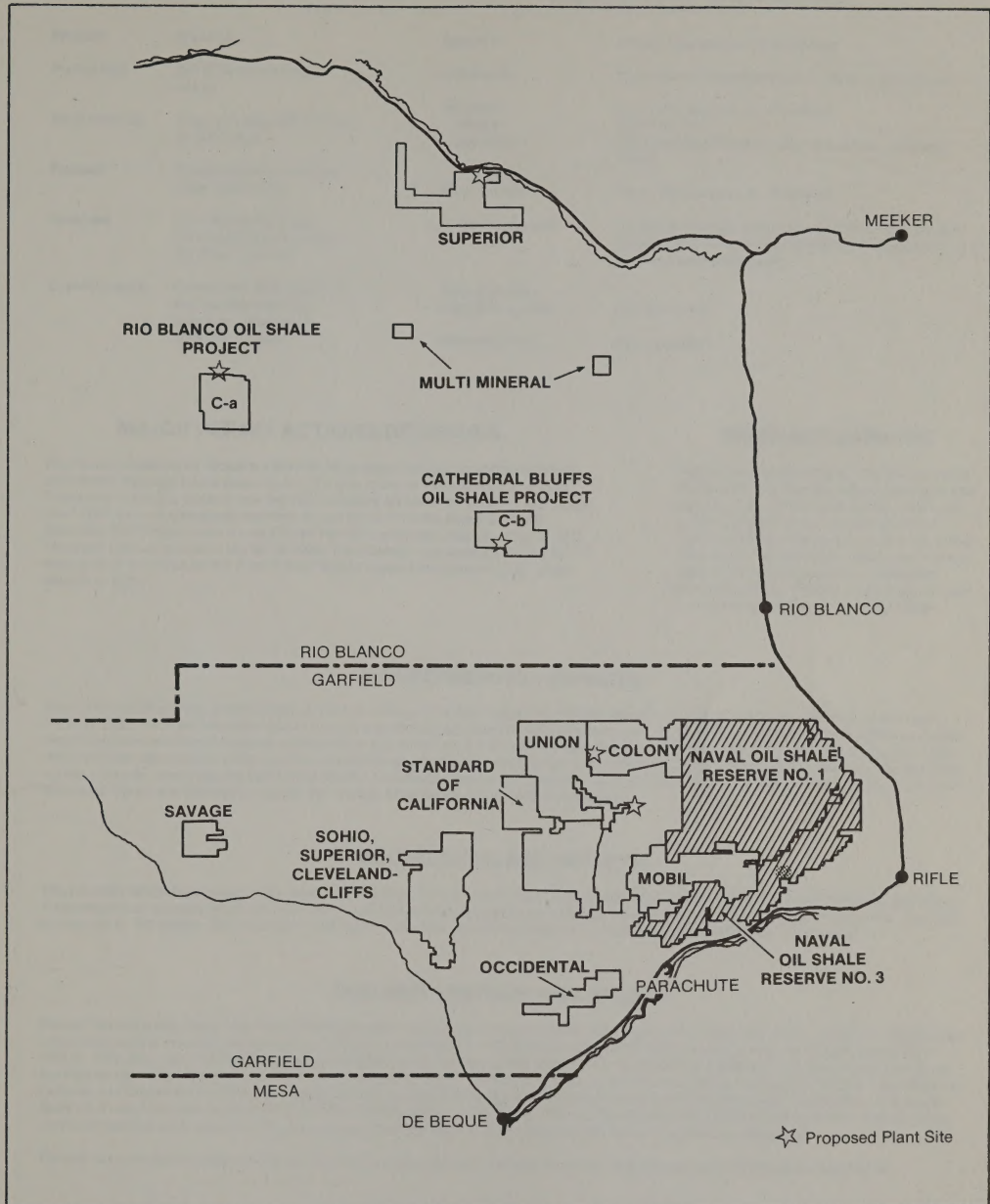
PROJECT/PROCESS DESCRIPTION

The Occidental modified in situ process for the recovery of shale oil consists of creating underground chambers of tightly packed but broken oil shale, in two steps: (1) underground mining and removal of a certain quantity of shale; (2) expanding the shale between the mined-out rooms into the rooms with conventional explosives. The mined-out area has the horizontal dimensions of the retort—the vertical dimension is proportional to the desired void space in the completed chamber. The chamber is sealed from the atmosphere before firing. The retorting of the broken shale is accomplished by drawing air with steam down through the broken shale. A combustion zone, in which residual carbon on the spent shale is burned, moves downward through the broken shale. Shale oil drains from the bed to the floor of the retort where it is collected in sumps and pumped to the surface. The gas produced in the process can be used to generate process steam or burned. This gas has a potential for power generation significantly in excess of the plant needs. The shale mined during initial retort construction is available for surface retorting. All waste rock from mining is to be revegetated.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

ACTIVITY	1974	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	
Field Testing														
Test Operations														

Paraho — Anvil Points



COLORADO

PLANT TYPE

Product: Shale oil

Production: 200 BPD (Semi-works retort)

Input Material: Approximately 300 TPD of 28 GPT shale

Process: Paraho aboveground patented technology

Location: Anvil Points Oil Shale Mine and Retorting Facility, Rifle, Colorado

Current Status: Operational with research and development programs on foreign and domestic shales

MANAGEMENT AND FINANCE

Sponsor: Paraho Development Corporation

Contractor: Development Engineering, Inc. (Paraho subsidiary)

Manager: Harry Pforzheimer, Jr., President
Phone: (303) 243-9550
Location: 300 Enterprise Building, Grand Junction, Colorado 81501

Key Contact: Harry Pforzheimer, Jr., President

Funds Expended: Approximately \$25 million expended in research and development work, and construction and operation of a pilot and semiworks plant.

Total Estimated Capital Required: Not applicable

Financing Plan: Not applicable

MAJOR PERMIT ACTIONS/DECISIONS

Paraho has obtained all necessary permits for present research and development operations. Possible future scale-up to a full-size retort or module facility at Anvil Points would require various new permits including an Environmental Impact Statement (EIS) and congressional approval to use shale from the Naval Oil Shale Reserves. DOE began work on an EIS for Paraho's proposed module retort in 1975. The draft EIS was issued in the fall of 1980. The operator has applied to DOE for an extension of the lease on the Anvil Points facility beyond the present lease which expires in 1982.

PRODUCT MARKETS

Paraho has produced over 110,000 barrels of crude shale oil. The majority of the crude was commercially refined into military products under contracts from the Department of Defense. These fuels included: jet fuels (JP-4, JP-5, and JP-8); gasoline; diesel; and marine diesel fuel. All products have undergone extensive testing. Paraho crude shale oil has been used by a utility in boiler fuel tests.

ENVIRONMENTAL IMPACTS

Paraho's technology has provided factual data on many of the environmental impacts associated with aboveground retorting of oil shale. Various DOE, EPA, and industry environmental monitoring programs have been conducted on disposal of retorted shale. Fugitive dust problems have been minimized because shale is lump size (+1/2" to -3 1/2") when entering the Paraho retort and the same size leaving the retort. Retorted shale reclamation programs have demonstrated successful compaction and vegetation techniques. Paraho's retorting process consumes no water. Water requirements for a Paraho commercial facility are projected to be one-half barrel of water for every barrel of shale oil produced. Water is additionally required for mining, reclamation, and plant infrastructure.

SOCIOECONOMIC IMPACTS

The counties which have received impacts from the Anvil Points Facility have a total population of approximately 80,000 (Garfield and Mesa). Total population increase is presently limited because the facility contains only research and development operations. Employment has varied from 30 to 128 people. The work force has been drawn from the towns of Grand Junction, Rifle, DeBeque, and Parachute.

PROJECT HISTORY AND STATUS

Paraho Development Corporation is an oil shale technology company organized in 1971 and based in Grand Junction, Colorado. Paraho has conducted several research and production programs. The Paraho Oil Shale Demonstration was privately funded by 17 participants from 1973 to 1976, at a cost of \$10 million, each participant receiving the right to enter into a non-exclusive, preferential license agreement to use the Paraho retorting technology. Oil yields averaged 90 percent. As a result of the successful demonstration program, the U.S. Department of Defense and Department of Energy awarded Paraho a number of production contracts to produce and ship up to 100,000 barrels of crude shale oil. Production was carried out at the Anvil Points facility from 1976 to 1978. A 105-day continuous on-stream operation and oil yields above 96 percent were obtained. The crude shale oil produced has been commercially refined into military products.

Paraho has processed foreign shales at Anvil Points and is planning additional foreign shale as well as domestic shale operations.

PROJECT/PROCESS DESCRIPTION

The Paraho retort is an aboveground vertical shaft vessel with a carbon steel shell and a refractory trick lining. Oil Shale rock from the crushing and storage plant, sized from +1/4" to 3-1/2" is fed into the top of the retort and flows downward by gravity as a continuously moving bed. As the shale moves downward in the retort, it passes through four zones:

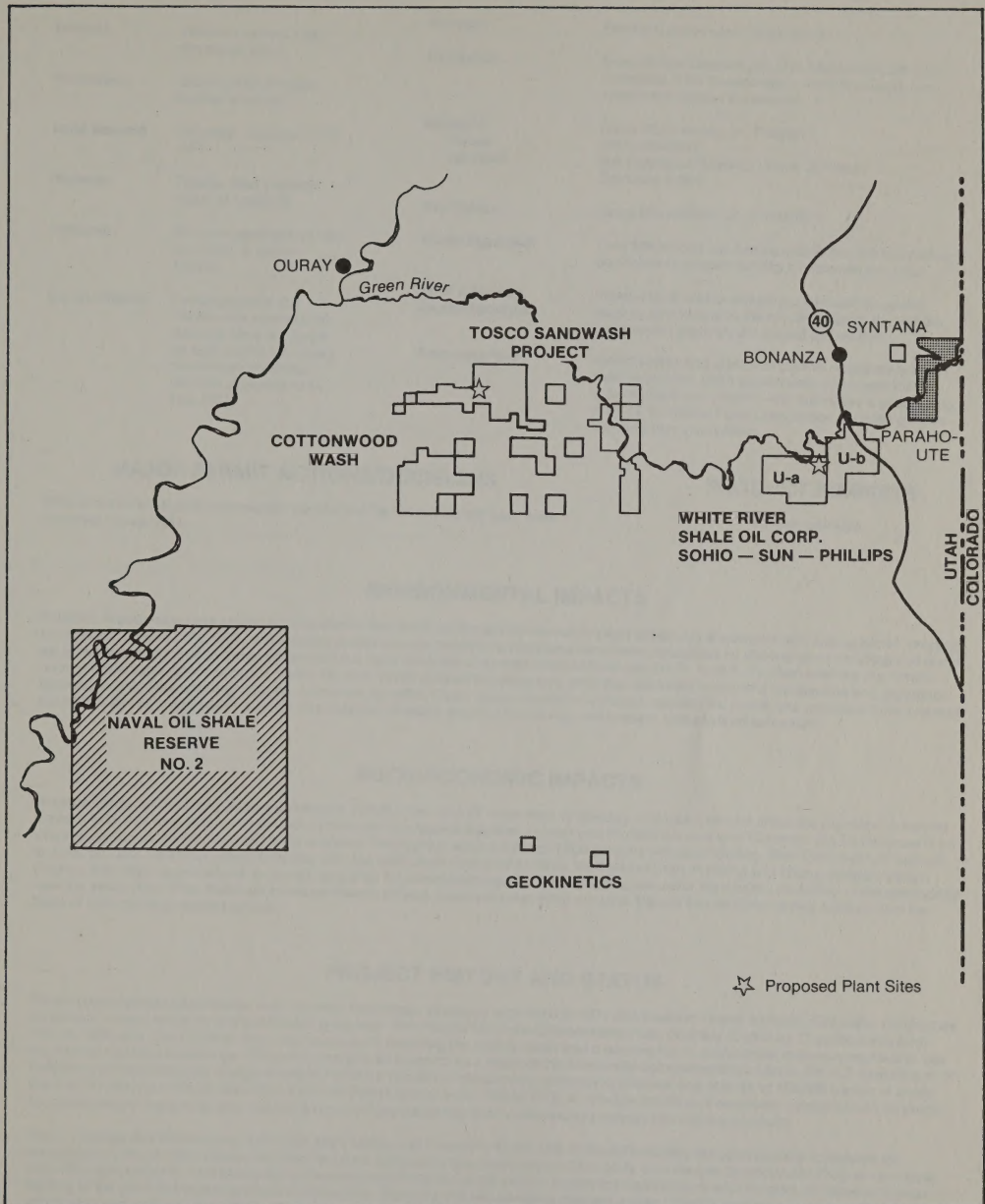
- **Mist Formation Zone** - As the ascending gas stream is cooled by descending raw shale entering the top of the retort, oil vapors condense into a stable mist which is collected and drawn off the top of the vessel.

Paraho — Anvil Points

- Retorting Zone - Descending preheated shale enters the retorting zone where it is heated by the hot gases arising from the combustion zone. When the shale is heated the organic matter (kerogen) decomposes and forms oil vapors, fixed gases, and leaves a carbon residue on the retorted shale.
- Combustion Zone - The zone extends below the retorting zone. Air along with recycled shale gas is injected through the top and middle distributors and distributed across the shale bed where ignition occurs. The burning of some of the gas and carbon residue provides the required process heat.
- Retorted Shale Cooling Zone - The principal function of this zone is to recover heat from the retorted shale before it leaves the vessel. The recovery of the heat enhances the combustion process by pre-heating a portion of the ascending air/gas mixture which is entering the base of the vessel. The retorted shale leaves the bottom of the vessel at a low temperature. As a result, no water is required for cooling the retorted shale. Retorted shale is reclaimed and revegetated.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

ACTIVITY	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Field Testing	_____									
Test Operations		_____	_____	_____	_____	_____	_____	_____	_____	_____
Production (B/D)					_____	_____	_____	_____	_____	_____
					(200)					



PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil, product gas, ammonia, sulfur	Sponsor:	Paraho Development Corporation
Production:	30,000 BPD of hydro-treated shale oil	Contractor:	Davy McKee Corporation, The Cleveland-Cliffs Iron Company, VTN Consolidated, AeroVironment, Inc., Woodward-Clyde Consultants
Input Material:	Oil shale - average of 28 GPT	Manager:	Harry Pforzheimer, Jr., President
		Phone:	(303) 243-9550
		Location:	300 Enterprise Building, Grand Junction, Colorado 81501
Process:	Paraho Direct Heated Mode of retorting	Key Contact:	Harry Pforzheimer, Jr., President
Location:	50 miles southeast of Vernal, Utah, in Uintah County.	Funds Expended:	Over \$25 million has been expended in the research and development phases leading to commercialization.
Current Status:	Construction of the Paraho-Ute commercial shale oil plant will begin as soon as the necessary permits are obtained, which is expected to be mid-1982.	Total Estimated Capital Required:	Present DOE and/or industry sponsored programs leading specifically to the construction of the Paraho commercial plant would exceed \$47 million.
		Financing Plan:	Construction and operation phases anticipate government incentives (loan guarantees) and a venture of industry sponsors. Paraho-Ute submitted a proposal to the U.S. Synthetic Fuels Corporation for price guarantees and loan guarantees.

MAJOR PERMIT ACTIONS/DECISIONS

PRODUCT MARKETS

Final environmental and construction permits for the full facility will have been obtained by late 1984.

No data available.

ENVIRONMENTAL IMPACTS

Paraho's experiments have produced important information on the environmental impacts previously associated with aboveground retorting of oil shale. Various DOE, EPA, and industry environmental monitoring programs have been conducted on aboveground retorting and disposal of retorted shale. Fugitive dust problems have been minimized because shale is lump size (+1/2" to -3 1/2") when entering the Paraho retort and the same size leaving the retort. Retorted shale reclamation programs have demonstrated successful compaction and vegetation techniques. Paraho's retorting process consumes no water. Water requirements for a Paraho commercial facility are projected to be one-half barrel of water for every barrel of shale oil produced. Water is required for mining, reclamation, and plant infrastructure.

SOCIOECONOMIC IMPACTS

Because the shale tract is 50 miles southeast of Vernal, Utah, and 27 miles west of Rangely, Colorado, several areas are expected to receive impacts from this proposed development. Uintah and Duchesne counties in Utah and Rio Blanco county in Colorado will be the areas from which a portion of the employment force is drawn. The highest employment of 1,800 persons will occur during 1984-1986, and will level off to 1,200 by 1987. Paraho is working closely with the Utah State Governor's Office, the State of Utah Planning and Energy Boards, Uintah County, and other organizations, to identify and plan for associated impacts. Various plans are under discussion, including a new community near the White River Dam Reservoir to house Paraho project employees and other persons. Paraho has received strong support from the State of Utah for its proposed project.

PROJECT HISTORY AND STATUS

Paraho Development Corporation is an oil shale technology company organized in 1971 and based in Grand Junction, Colorado. Paraho has conducted several research and production programs. The Paraho Oil Shale Demonstration was privately funded by 17 participants from 1973 to 1976, at a cost of \$10 million, each participant receiving the right to enter into a non-exclusive, preferential license agreement to use the Paraho retorting technology. Oil yields averaged 90 percent. As a result of the successful demonstration program, the U.S. Department of Defense and Department of Energy awarded Paraho a number of production contracts to produce and ship up to 100,000 barrels of crude shale oil. Production was carried out at the Anvil Points facility from 1976 to 1978. A 105-day continuous on-stream operation and oil yields above 96 percent were obtained. The crude shale oil produced has been commercially refined into military products.

Phase I Design and Engineering (DE-FC03-80ET14103) and Feasibility Study (DE-FG01-80RA50385) are optimistically scheduled for completion by fall of 1981. Paraho has also received notification of acceptance by DOE of its Commercial Development Program proposal (DE-PS01-80RA-50413). This Commercial Development Program (a 435 million cooperative agreement) will complete all necessary steps leading to the point of beginning actual construction. The program will complete detailed design, identify, and order long-lead time items of equipment, and apply for and obtain all necessary permits. Scheduled program start is during the first quarter of 1981, however, Federal funding for the final engineering cooperative agreement is uncertain pending current budget discussions.

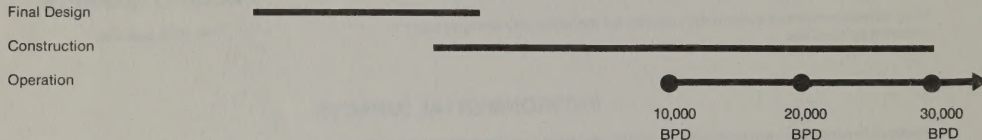
If current plans can be realized on schedule, construction of the Paraho Facility could begin by mid-1982 with production of 10,000 (BPD) by late-1984; 20,000 BPD by 1985 and 30,000 BPD in mid-1986. Paraho expects to fund construction and operation of the facility through such government incentives as a loan guarantee, along with a venture of industry sponsors.

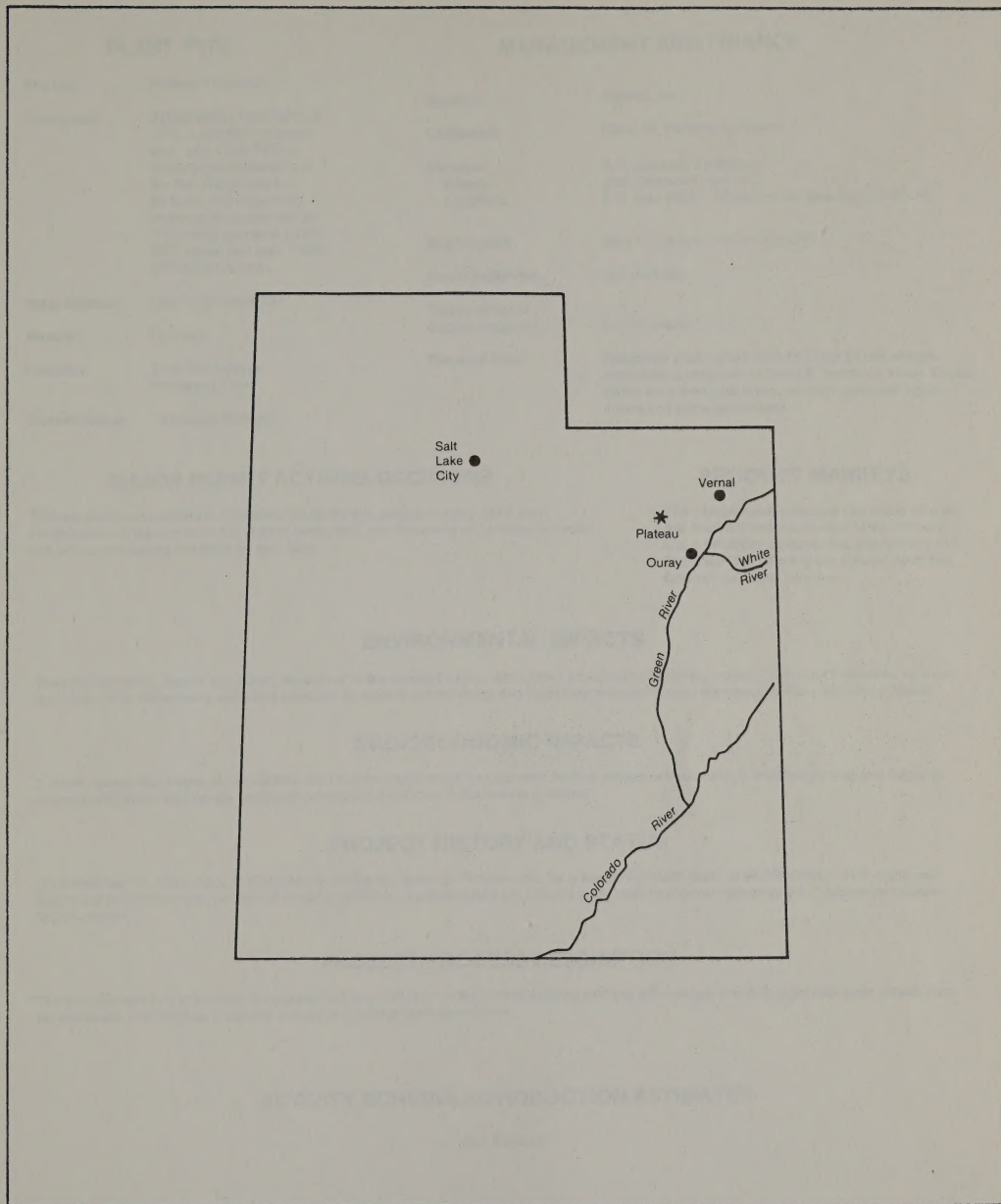
bed. As the shale moves downward in the retort, it passes through four zones:

- retorted shale. Retorted shale is reclaimed and revegetated.

approximately 130 feet long, 25 feet wide and 100 feet high, with capabilities of producing 10,000 BPD of shale oil.

ITY SCHEDULE/PRODUCTION ESTIM





PLANT TYPE

Product: Refined Products

Production: 20,000 BPD (7,000 BPD of JP-4, 1,000 BPD of gasoline, and 1,000 BPD of military grade diesel fuel for the Department of Defense, the remaining shale oil products will be 7,000 BPD gasoline, 2,000 BPD diesel fuel and 1,000 BPD of jet-A fuel.)

Input Material: Upgraded Shale Oil

Process: Refinery

Location: One mile west of Roosevelt, Utah

Current Status: Operating Refinery

MANAGEMENT AND FINANCE

Sponsor: Plateau, Inc.

Contractor: Ralph M. Parsons Company

Manager: A.C. Leonard, President
Phone: (505) 262-2221, Ext. 623
Location: P.O. Box 26251, Albuquerque, New Mexico 87110

Key Contact: Paul W. Liscom, Project Director

Funds Expended: Not available

Total Estimated Capital Required: \$5.016 million

Financial Plan: Feasibility study grant from DOE for \$4.056 million. Submitted a proposal to the U.S. Synthetic Fuels Corporation for a loan guarantee, product purchase agreements and price guarantees.

MAJOR PERMIT ACTIONS/DECISIONS

Plateau plans to complete a Feasibility Study for the project in early 1982. Field construction of the complex will start in early 1983, and the shale oil processing facilities will be producing products by late 1984.

PRODUCT MARKETS

The complex will include a raw shale oil pipeline from the supply sources to the refinery and a products pipeline from the refinery to Salt Lake City where it will connect with the Chevron products pipeline.

ENVIRONMENTAL IMPACTS

The environmental, health and safety aspects of this proposed project are similar to a crude oil refinery project. The use of pipelines to move raw shale oil to the refinery and most products to market will minimize any additional emissions from transporting the additional material.

SOCIOECONOMIC IMPACTS

It is anticipated that many of the construction workers who move into the area for this project will relocate to shale oil mining and retorting projects afterwards and hence represent permanent additions to the area population.

PROJECT HISTORY AND STATUS

On December 11, 1980, the U.S. Department of Energy selected Plateau, Inc., for a feasibility study grant of \$4.056 million. This study will determine the commercial viability of modifying Plateau's existing refinery at Roosevelt, Utah to process raw shale oil. Total project cost is \$5.016 million.

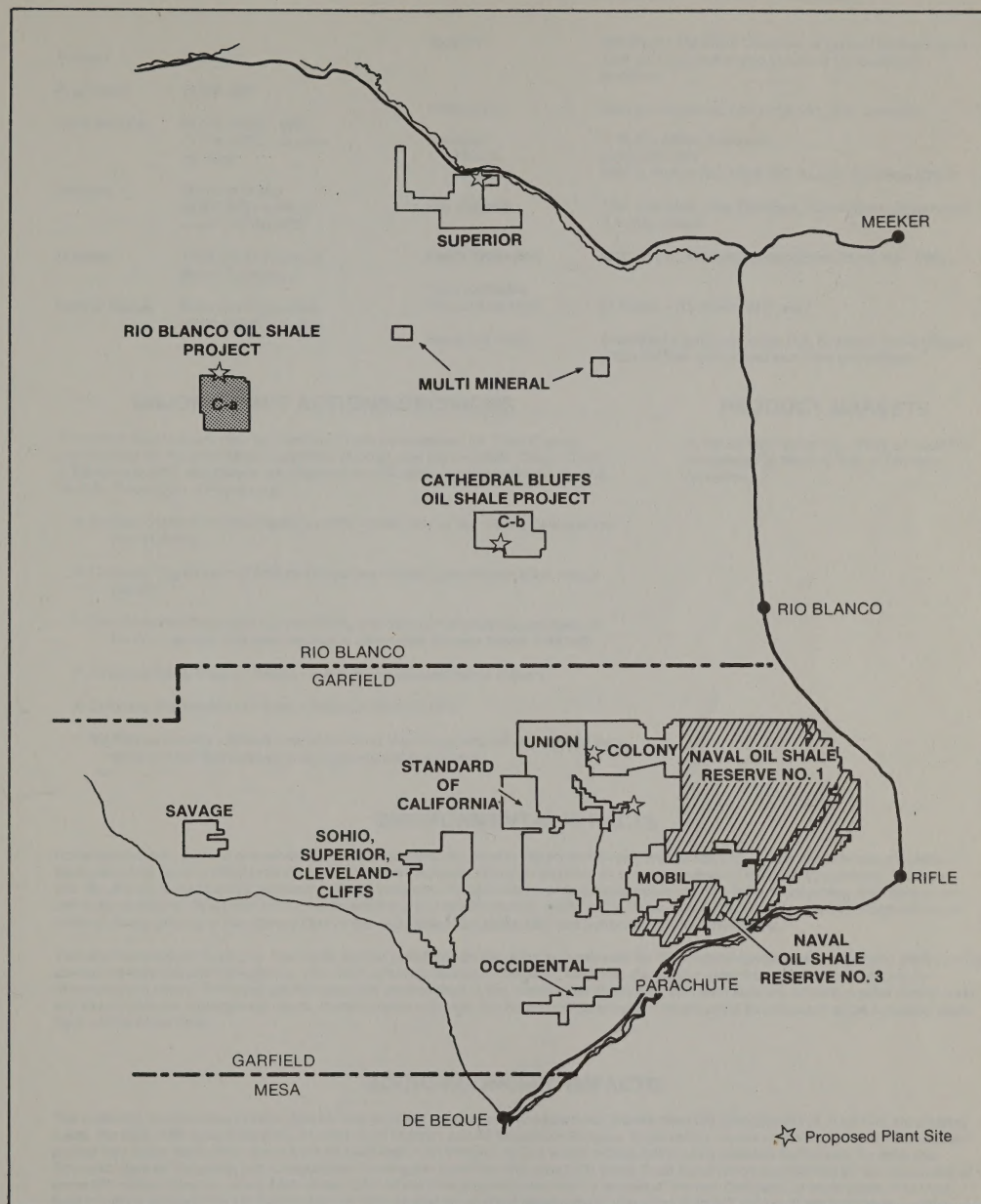
PROJECT/PROCESS DESCRIPTION

The process which is proposed to upgrade raw shale oil is an extension of existing refining technology, and the upgraded shale oil will then be processed into finished products using conventional petroleum units.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

Not Available

Rio Blanco (C-a)



COLORADO

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil	Sponsor:	Rio Blanco Oil Shale Company, a general partnership of Gulf Oil Corporation and Standard Oil Company (Indiana)
Production:	76,000 BPD	Contractor:	Morrison-Knudsen Company, Inc., C.E. Lummus
Input Material:	98,000 TPSD - MIS 72,000 TPSD - Surface retorting	Manager:	J. Blaine Miller, President (303) 695-2400
Process:	Modified in situ - 38,000 BPD Surface retort - 38,000 BPD	Phone:	2851 S. Parker Rd., Suite 500, Aurora, Colorado 80014
Location:	Tract C-a in Piceance Basin, Colorado	Location:	
Current Status:	Shaft sinking, surface construction activities	Key Contact:	Tom Ten Eyck, Vice President, Community, Government & Public Affairs
		Funds Expended:	\$260 million (Modular Development Phase thru 1/80)
		Total Estimated Capital Required:	\$1 billion + (Commercial phase)
		Financing Plan:	Submitted a proposal to the U.S. Synthetic Fuels Corporation for loan guarantees and price guarantees.

MAJOR PERMIT ACTIONS/DECISIONS

PRODUCT MARKETS

A Detailed Development Plan for modified in situ development for Tract C-a was approved by the Area Oil Shale Supervisor (AOSS) now the Oil Shale Office (OSO) in September 1977. Rio Blanco has acquired the following major permits for the MIS Modular Development Phase only:

In the commercial phase, shale oil would be transported to existing Gulf or Standard refineries.

- Environmental Protection Agency (EPA) - Prevention of Significant Deterioration Permit (PSD)
- Colorado Department of Natural Resources - Mined Land Reclamation Permit (MLR)
- Environmental Protection Agency (EPA) and State of Colorado Department of Health - National Pollution Discharge Elimination System Permit (NPDES)
- Colorado Department of Health - Subsurface Disposal Permit (Water)
- Colorado Department of Health - Emission Permit (AIR)
- Rio Blanco County - Special Use of the Land Similar permits will be required for a surface retort demonstration and commercial operations.

ENVIRONMENTAL IMPACTS

Completion of two years of environmental baseline studies plus continuing environmental monitoring will provide considerable scientific background for surface effects resulting from C-a development. Although modified in situ was covered in the 1973 Department of Interior EIS, Rio Blanco is researching potential pollution problems of subsidence, underground retort leaching following burning, and other environmental questions. Revegetation studies have been underway for several years on Tract C-a. Negligible impacts on wildlife, agriculture, or cattle or sheep grazing in Rio Blanco County are anticipated due to the MIS and surface retort demonstrations.

Two aquifers exist on Tract C-a. The upper aquifer runs through the retort area planned for the modular development phase and shaft sinking operations have required dewatering. The water primarily has been reinjected back into the aquifer away from the mine site during the demonstration phase. The lower aquifer would be encountered in the commercial phase and, with both aquifers present, a great deal of water will be available for development needs. If additional is required, Rio Blanco holds an option which could be exercised on an industrial water right on the White River.

SOCIO-ECONOMIC IMPACTS

The Colorado communities of Rifle, Meeker and Rangely are expected to experience growth from the development of Tract C-a. By existing roads, the tract is 58 miles from Rifle, 51 miles from Meeker, and 68 miles from Rangely. Engineering studies made in 1974 and 1975 demonstrated that a new road which could be built southeast from Rangely to C-a would reduce commuting distance to 25 miles. To date, the Colorado General Assembly has not approved funding the road from the state's Oil Shale Trust Fund which was created by the placement of some \$70 million from the nearly \$200 million paid to the federal government by the lessees of the two Colorado oil shale tracts. The trust fund money is primarily for socioeconomic impacts caused by oil shale development, and more than \$47 million of the total placed in the state fund came from payments made by the lessees of Tract C-a. During the initial modular development phase of construction through part of 1982, employment is not anticipated to exceed 380 workers, with fewer than that number for the majority of the period. A commercial scale production level of 76,000 BPD could result in permanent employment for about 2,500 workers. Rio Blanco is developing housing and transportation plans for its workers; the company now underwrites a mobile home park in Rangely and is planning another for Meeker. More than 90 percent of Tract C-a employees are transported to and from work by buses and vans. Rio Blanco Oil Shale Company works with state and local officials in identifying socioeconomic impacts and in planning mitigative measures.

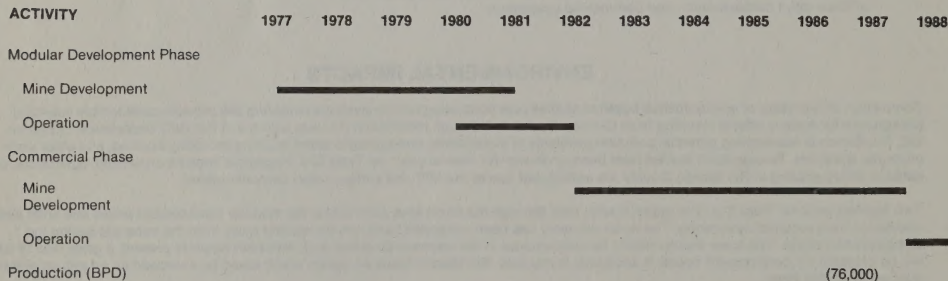
PROJECT HISTORY AND STATUS

Tract C-a was offered for lease January 8, 1974 by closed bids by the U.S. Department of the Interior. Gulf Oil Corporation and Standard Oil Company (Indiana) acquired the lease officially on March 1, 1974; the total amount bid was \$210.3 million. The two companies later formed the Rio Blanco Oil Shale Company, a general partnership, to develop the tract. In accordance with terms of the lease, three annual payments of about \$42 million each have been made. The final two payments were offset by the Area Oil Shale Supervisor (now Deputy Conservation Manager/Oil Shale) by approved tract development expenses. Originally, Tract C-a was to be developed by open-pit methods as projected in the Interior Department environmental impact statement. However, the Department was not legally able to make additional federal land available for disposal of processed shale and overburden. Because of this and other constraints, the lessees decided to develop the tract by underground modified in situ methods. Following submittal of an open-pit Detailed Development Plan in 1976 and a one-year suspension of operations, the lessees submitted a revised DDP which was approved in September 1977. Shaft sinking began later that year and was completed in the fall of 1979. In February 1979, the Rio Blanco Oil Shale Company purchased the modified in situ technology of Occidental Oil Corporation. A technical modification involving the method of constructing the modified in situ retort and retort configuration was submitted to the Department of Interior on June 28, 1979. This resulted from technical information developed by Rio Blanco Oil Shale Company and acquired since the detailed development plan was approved on September 22, 1977. The first MIS retort was burned starting in October 1980 and was completed at the end of December 1980. Results presently are being evaluated. Construction is anticipated to begin on a surface retort utilizing Lurgi technology in 1981. Operation of the retort is scheduled to begin approximately mid-1983. Ore would be obtained from a small open pit located in the northwest corner of Tract C-a. The process plant and support facilities will be located on Rio Blanco's private property adjacent to and north of Tract C-a. The spent shale will be disposed of on this private property. A modification to the DDP to include the Lurgi Demonstration Project was submitted to the Oil Shale Office in early February 1981. Permit applications presently are being submitted to various government agencies. A decision to construct will follow Lurgi surface retort operation — approximately late 1983 through 1984. Operation of the first commercial increment of capacity could begin in the late 1987 through 1988 time frame.

PROJECT/PROCESS DESCRIPTION

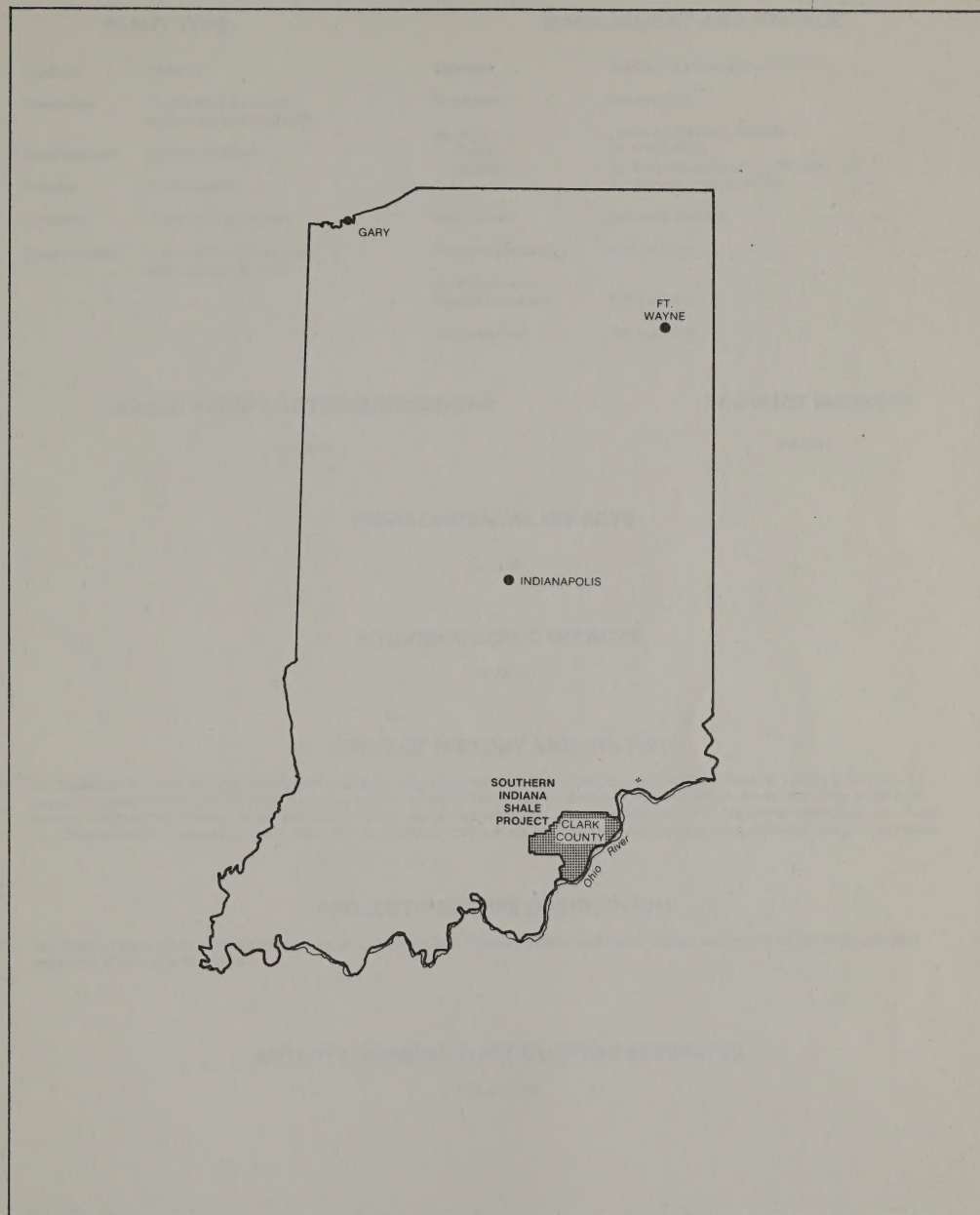
The C-a Federal Prototype Oil Shale Lease is located at the head of Yellow Creek on the western edge of the Piceance Creek Basin of north western Colorado (R99W between T1S and T2S). The 5,090-acre tract has a potential recoverable shale oil reserve between 1.3 and 5.2 billion barrels, depending on extraction method (open pit, underground room-and-pillar, or modified in situ). Maximum daily production by open pit was estimated at 300,000 BPD. Maximum for modified in situ (MIS) is projected at 200,000 BPD. The Rio Blanco Oil Shale Company is engaged in a modular development phase to prove the commercial viability of the MIS process. Some \$93 million initially was authorized by Gulf and Standard to burn a series of underground retorts. The program is expected to be completed by 1982. Commercial development efforts could begin shortly after completion of the MDP which would lead to a commercial production level of 76,000 BPD by 1987—at the earliest. Production would consist of 38,000 BPD by underground modified in situ mining and processing and 38,000 by surface retorting. The MIS method involves removing some 40 percent of the desired underground retort void space and bringing that ore material to the surface to be surface retorted. After removal of the material from underground, the retort is rubblized and burned and the shale oil is pumped to the surface. Rio Blanco Oil Shale Company presently is studying the commercial viability of an open pit/surface retort operation. A commercial decision for developing Tract C-a is expected to be made in 1982/83.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES



Note: Schedule assumes availability of financial incentives and no major permit delays.

Southern Indiana



INDIANA

PLANT TYPE

Product: Shale oil
Production: 10,000 BPD, eventually expanding to 50,000 BPD
Input Material: Eastern oil shale
Process: Undetermined
Location: Clark County, Indiana
Current Status: A \$6.5 million study grant was awarded by DOE

MANAGEMENT AND FINANCE

Sponsor: Southern Indiana Shale Oil Co., Inc.
Contractor: Not available
Manager: James M. Robison, President
Phone: (317) 392-4886
Location: 45 West Washington St., P.O. Box 748
Shelbyville, Indiana 46176
Key Contact: James M. Robison
Funds Expended: Not available
Total Estimated Capital Required: Not available
Financial Plan: Not available

MAJOR PERMIT ACTIONS/DECISIONS

No Data

PRODUCT MARKETS

No Data

ENVIRONMENTAL IMPACTS

No Data

SOCIOECONOMIC IMPACTS

No Data

PROJECT HISTORY AND STATUS

On December 11, 1980, the U.S. Department of Energy announced the selection of the Southern Indiana Shale Oil Co. for \$6.48 million to assess the feasibility of construction of a plant to produce shale oil from Eastern oil shale. Time requirement for the feasibility study is 18 months. Proposed subcontractors are Mittelhauser Corp., Ralph M. Parsons Co., A. J. Kearney, Inc., S. K. Meuchner Associates, Inc., Furgo, Inc., Bowser-Morner Testing Labs, Inc., and UOP, Inc. Initiation of the study has been delayed pending current Federal budget discussions.

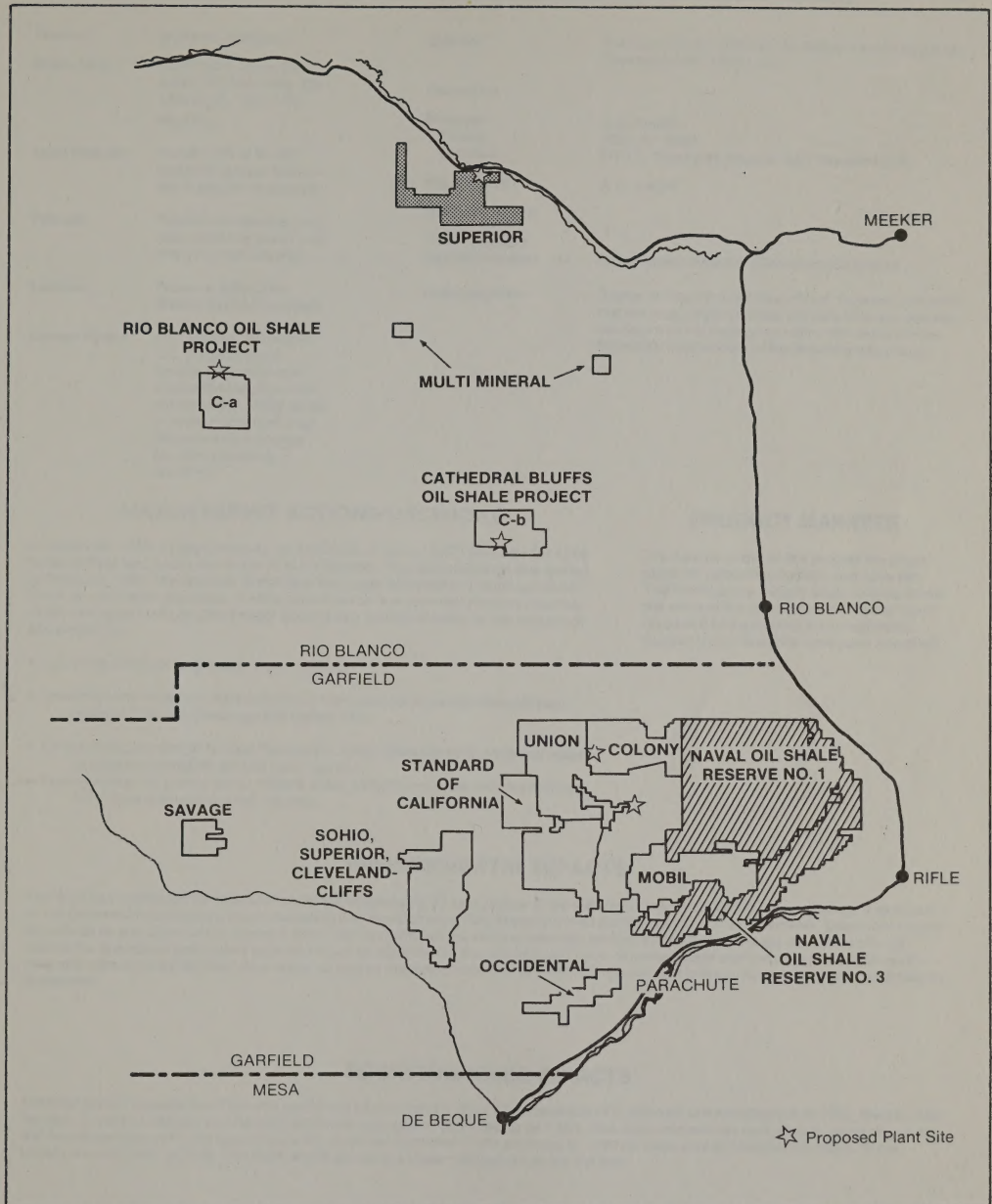
PROJECT/PROCESS DESCRIPTION

The shale oil plant under consideration would be located in Clark County, Indiana, and have a design capacity of 10,000 BPD, with later expansion to 50,000 BPD planned.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

Not available

Superior multiminerall



COLORADO

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil, minerals	Sponsor:	The Superior Oil Company 60 percent, Sohio 30 percent, Cleveland-Cliffs 10 percent.
Production:	13,000 BPD Shale Oil, 4,000 TPD Nahcolite, 700 TPD Al_2O_3 1,500 TPD Na_2CO_3	Contractor:	
Input Material:	26,000 TPD of 25 GPT shale, 20 percent Nahcolite, 7 percent Dawsonite	Manager:	J. H. Knight
Process:	Proprietary retorting process (traveling grate) and retorted shale leaching	Phone:	(303) 761-5853
Location:	Piceance Basin, Rio Blanco County, Colorado	Location:	2750 S. Shoshone, Englewood, Colorado 80110
Current Status:	Pilot studies completed; U.S. Department of Interior evaluation and environmental statement are complete. DOI's dollar evaluation and exchange decision and exchange decision are being appealed.	Key Contact:	J. H. Knight
		Funds Expended:	
		Total Estimated Capital Required:	Project costs expected to exceed \$300 million
		Financing Plan:	Source of financing not determined. Superior contends that the multi-product (shale oil, nahcolite and dawsonite) nature of the project may allow the venture to be financially independent of the federal government.

MAJOR PERMIT ACTIONS/DECISIONS

In November 1973, an application for an exchange of land of 2,571 fee acres for 1,769 acres of BLM land was made to the BLM by Superior. The land exchange was denied in February, 1980. The approval of this land exchange will result in a more economic block of extractable resources. Further permit action is suspended pending approval of the exchange by BLM. Other major government permits needed for the success of this project are:

- U.S. Army Corps of Engineers - Creek conduit
- Environmental Protection Agency (EPA) - Spill prevention countermeasure plan; National Pollution Discharge Elimination Plan
- Colorado Department of Natural Resources - Spent shale disposal; wells and water use; land reclamation; air and water quality.
- Superior does not plan to utilize surface water, as sufficient water will be produced from mine drainage and salt aquifers.

PRODUCT MARKETS

The four products of this process are crude shale oil, nahcolite, alumina, and soda ash. The minerals are roughly equal to three times the value of the oil in terms of financial return on capital and operating costs expended. Customers for nahcolite have been identified.

ENVIRONMENTAL IMPACTS

The BLM has completed the final Environmental Statement (ES) as a portion of the information required for the land exchange. The appeal of the Department of Interior's dollar evaluation and decision regarding Superior's land exchange timing is undetermined. Spent shale disposal will not be a problem at the Superior plant. The extraction of marketable nahcolite and dawsonite from the shale (as well as oil) will reduce the quantity of spent shale such that it can be backfilled in the underground mine. Superior would use nahcolite to eliminate sulfurous and nitrous emissions from its process, as well as marketing nahcolite to power companies and other customers for stack gas emission abatement.

SOCIOECONOMIC IMPACTS

Potential socioeconomic benefits and impacts will be discussed in the above-mentioned ES. Affected communities will be Rifle, Meeker, and Rangely, Colorado. Meeker and Rangely both have populations estimated to be 1,800. New area residents are estimated to be employed at 900 new shale jobs and 1,400 support jobs for continued operation of the plant (up to 1,350 on shale jobs at construction peak). Some impact also will occur at Rifle, Colorado, which serves as a major railroad center for the area.

PROJECT HISTORY AND STATUS

Superior has acquired mineral right ownership of about 6,750 acres of private land bordering the White River at the northern edge of the Piceance Basin, Colorado (6,000 acres of tract are shale-bearing). In November 1973, Superior applied to the BLM for exchange of private lands within the leased tract for certain public lands being managed by BLM. BLM denied the land exchange on February 5, 1980. Superior has made no significant actions other than the above-mentioned application that moves the project closer to construction. Superior has been conducting laboratory and pilot testing of facility components and processes; it also has conducted feasibility studies in the area of mining, retorting, mineral processing, and product markets. In 1980, Superior consummated a shale resource agreement with Sohio and Cleveland-Cliffs in which Superior gained a 20 percent working interest in the Pacific oil shale project and provided a 30 percent Sohio and 10 percent Cleveland-Cliffs interest in Superior's mineral/oil shale resource.

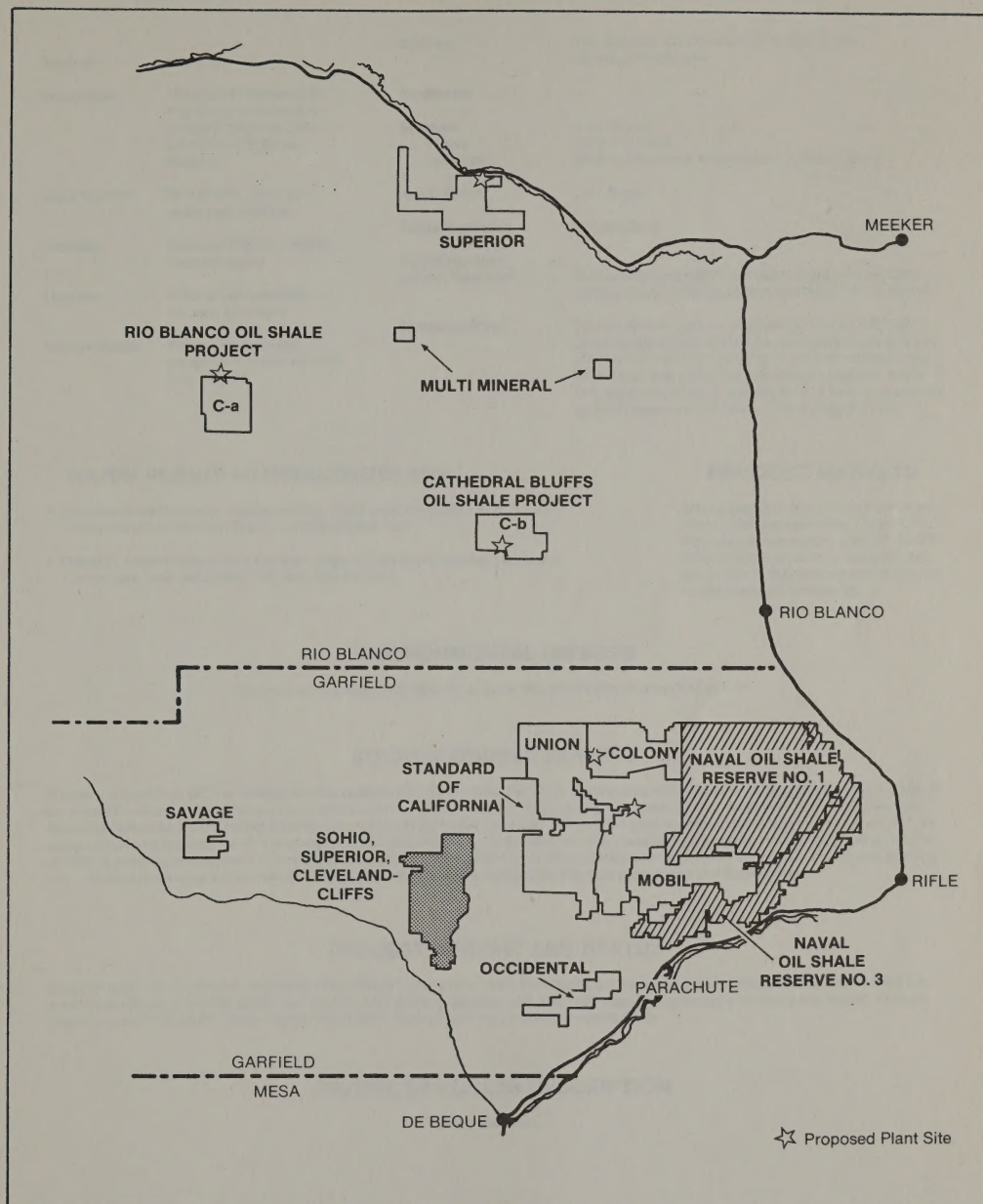
PROJECT/PROCESS DESCRIPTION

Shale of 6 x 100 mm (1/4 x 4 in) size is fed to the continuously rotating grate through inert gas purged mechanical seals. The resulting bed of shale rotates into the heating zone where oil is evolved and carried away with the circulating gas heating media. The circulating gas with oil mist passes through oil removal equipment where oil and water are removed. The retorted shale is passed through the carbon recovery zone where residual carbon is partially oxidized and oil evolution is completed. It then continues into the shale cooling zone. Recycle gas is heated in the shale cooling zone by recovering sensible heat from the hot retorted shale. The shale is further cooled by ambient air which is heated for use in the direct fired burners or alternately in the indirect heater. This energy recovery improves thermal efficiency. Spent shale is discharged either by mechanical seals or a water seal which wets the shale for dust control. The rotating grate is sealed between stationary hoods on top of the bed and windboxes underneath by water troughs on both sides of the shale bed. Preheated recycled gas from the shale cooling zone is further heated by mixing with hot combustion gases of 1370 to 1650C (2500 to 3000F). The resulting gas mixture, at 680 to 815C (1250 to 1500F), is introduced into the shale heating zone completing its cycle. Product gas is taken as a slip stream from the recycling heating media gas. A medium BTU gas of 14 900 to 22 400 kJ/m³ (400 to 600 BTU/SCF) (depending on grade of feed shale) is produced by using the indirect heating mode. The gas produced from direct heating is diluted by combustion gases (CO₂ and N₂) and has a heating value of 3000 to 4200 kJ/m³ (80 to 130 BTU/SCF) depending on shale grade. This gas product stream is compressed to 445 kPa (50 psig), and additional water-oil is condensed and removed prior to leaving the retorting process.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

ACTIVITY	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Planning & Design	Complete										
Permits & Mobilization											
Land Exchange (In appeal)											
Construction						Pending DOI's decision					
Operation									Pending DOI's decision		
Daily Production (B/D)											(11,590)

Note: Schedule assumes no major permit delays. Modular construction is planned with 3,000 to 5,000 T/D Nahcolite, 11,000 to 13,000 B/D, 600 to 800 T/D Al₂O₃ and 1,200 to 1,600 T/D NA₂CO₃ (20,000 T/D shale feed) single module.



COLORADO

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil	Sponsor:	The Superior Oil Company 20%; Sohio 60%; Cleveland-Cliffs 20%
Production:	15,000 BPD Demonstration Plant; increasing to 3-15,000 BPD modules, 2.6 million GPD (per module)	Contractor:	
		Manager:	J. H. Knight
		Phone:	(303) 761-5853
		Location:	2750 S. Shoshone, Englewood, Colorado 80110
Input Material:	22,000 TPD of 32 GPT shale (per module)	Key Contact:	J. H. Knight
Process:	Superior Oil/Davy McKee (circular grate)	Funds Expended:	Not Available
Location:	West of Rifle, Garfield County, Colorado	Total Estimated Capital Required:	Demonstration project cost expected to exceed \$300 million. 50,000 BPD plant cost estimated at \$1.3 billion.
Current Status:	Phase I engineering design and permit acquisition started	Financing Plan:	Source of financing on engineering Phases I & II of demonstration unit is DOE-Superior cost sharing. Construction (Phase III) financing is undetermined at this time. Cleveland-Cliffs has submitted a proposal to the U.S. Synthetic Fuels Corporation for a loan guarantee of up to 75 percent of its share of total project costs.

MAJOR PERMIT ACTIONS/DECISIONS

- Environmental Protection Agency (EPA) - Spill prevention countermeasure plan; National Pollution Discharge Elimination Plan
- Colorado Department of Natural Resources - Spent shale disposal; wells and water use; land reclamation; air and water quality.

PRODUCT MARKETS

The products of this process are crude shale oil of approximately 15,000 BPD from the demonstration module, 50,000 BPD or more could be produced upon expansion of the demonstration module to full plant size (Phase IV).

ENVIRONMENTAL IMPACTS

Superior is providing DOE detailed data on the description of proposed action.

SOCIOECONOMIC IMPACTS

Superior is providing DOE additional socioeconomic data at this time. Potential socioeconomic benefits and impacts will be discussed in the above mentioned EIS. Affected communities will be Grand Junction, DeBeque, and to some extent, Parachute and Rifle, Colorado. New area residents are estimated for employment at 400 new shale jobs and 700 support jobs in operating the demonstration plant. The construction employment for all 3 modules peaks at 2,800 in 1988; for the first module, construction employment peaks at 2,200 in 1984 or 1985. Operating employment is projected to be approximately 740 for the first module and 1,400 for all 3 modules. Additional housing and community services will be needed. The exact extent of these needs will be further determined at a future date.

PROJECT HISTORY AND STATUS

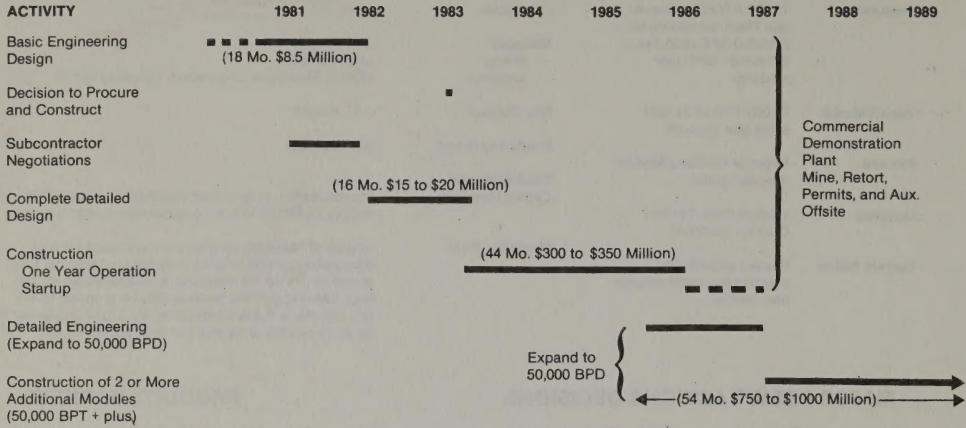
Superior acquired 20 percent ownership of the Pacific property in 1980. The Pacific property is on the southwestern corner of the Piceance Creek Basin, Colorado (8,000-acre tract is high grade shale-bearing). The 1980 resource agreement results in the Pacific oil shale property ownership as 60 percent Sohio, 20 percent Superior and 20 percent Cleveland-Cliffs.

PROJECT/PROCESS DESCRIPTION

Not available.

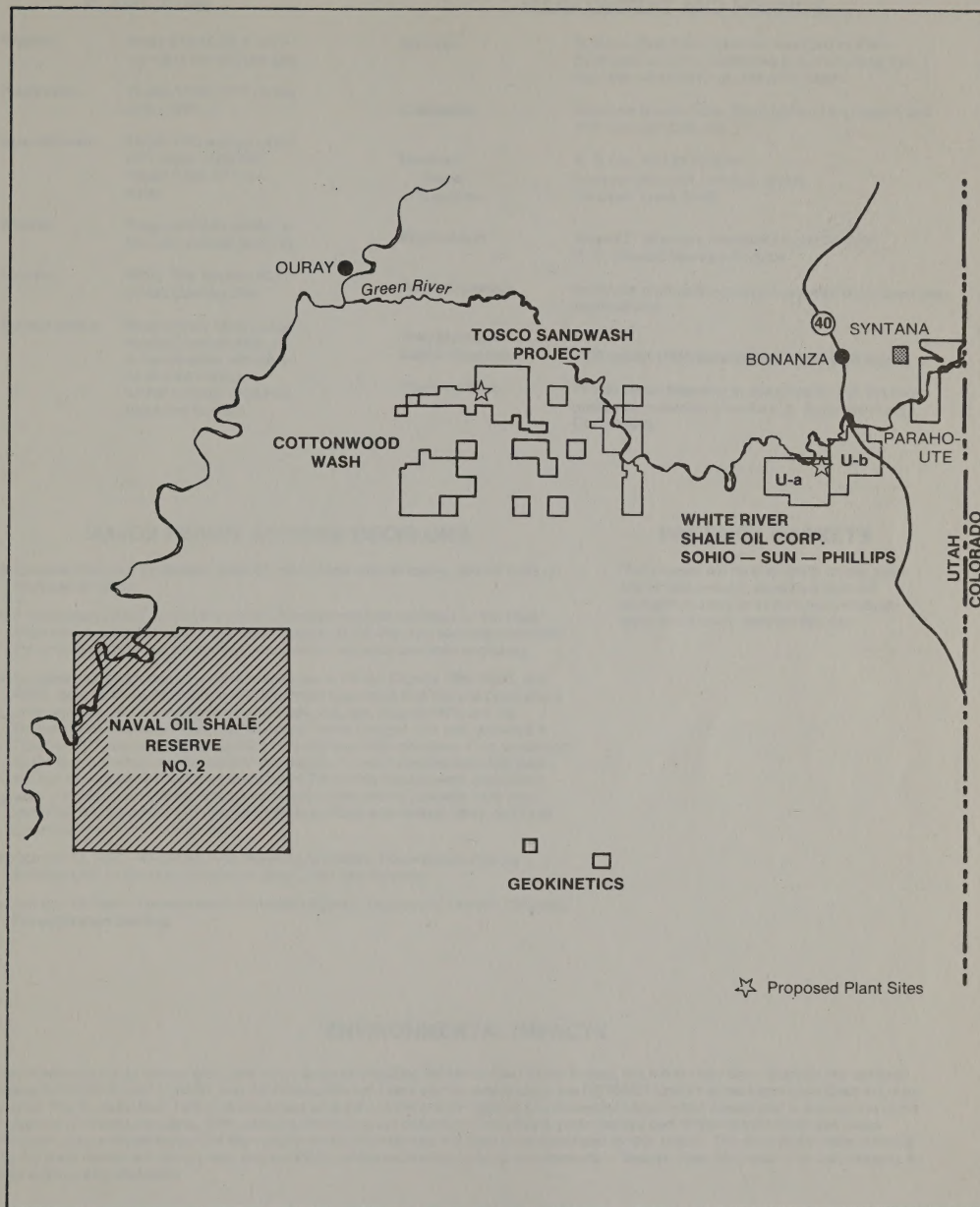
ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

Pacific Property Oil Shale
Tentative Overall Development Plan
12/20/80



NOTE: Schedule assumes no major permit delays. Modular construction is planned for a 15,000 BPD single module. Resource size allows for future expansion to 50,000 BPD plus.

(All costs in 1980 dollars)



UTAH

PLANT TYPE

Product: Shale oil and a low heating value combustible gas

Production: 16,500-50,000 BPD by the early 1990's

Input Material: 24,500 TPD and up, of 25 GPT shale - approximately 3,000 AF/Y of water

Process: Deep mining in combination with surface retorting

Location: R25E, T9S, Section 16 in Uintah County, Utah

Current Status: Mine/surface facility engineering studies underway in combination with additional field drilling to further quantify resource, assay and location.

MANAGEMENT AND FINANCE

Sponsor: Syntana-Utah a joint venture organized by the Synthetic Oil Corp., Oklahoma City, Oklahoma and Quintant Minerals Corp., Houston, Texas

Contractor: Morrison-Knudsen Co., Davy McKee Corporation, and VTN Consolidated, Inc.

Manager: R. E. Lee, Project Director
Phone: Syntana-Utah, 601 Jefferson Street,
Location: Houston, Texas 77002

Key Contact: Wayne E. Shannon, Assistant Project Director
 T. C. Driscoll, Manager-Finance

Funds Expended: In excess of \$1 million—combined prior and current year expenditures.

Total Estimated Capital Required: \$300 million (1980 dollars) for a 10,000 BPD facility

Financing Plan: Private sector financing in combination with the loan guarantee requested from the U.S. Synthetic Fuels Corporation.

MAJOR PERMIT ACTIONS/DECISIONS

- Syntana-Utah Unit #1 process shale oil mined from mineral leases held on State of Utah owned lands.
- A preliminary description of the Unit #1 development was approved by the Utah Department of Natural Resources. Utah Division of Oil, Gas and Minerals approved the current field drilling program to better define resource location and assay.
- Syntana-Utah properties of current interest are in Uintah County, T9S, R25E, and R24E, close to White River Shale Project. Project sponsors find that the Department of Energy final EIS for the prototype oil shale program, August 1973, and the Environmental Baseline Report applicable to Tracts U-a and U-b, and prepared in October 1977, are partially applicable to the Syntana-Utah activities. Thus prolonged onsite environmental monitoring and development of an environmental data base will not have to be developed by this project. Permitting requirements associated with 15 separate categories of required project development activities have been identified, and these permit issuances will be pursued with federal, state, and local government units as appropriate.
- October 14, 1980 - Presentation of Preliminary Detailed Development Plan by Syntana-Utah to the Utah Division of State Lands and Forestry.
- January 19, 1981 - Environmental Protection Agency, Region VIII, Denver, Colorado, Pre-application meeting.

PRODUCT MARKETS

The product will be a synthetic crude, suitable for tanker-truck, pipeline and/or rail transport to refiners in the west and southwest, and a low to medium Btu gas.

ENVIRONMENTAL IMPACTS

Site is surrounded by several proposed major projects including the White River Shale Project, the White River Dam, shale facility developments by PARAHO and TOSCO, and the construction of a new electric power plant, the DESERET Unit #1 of the Moon Lake Electric Cooperative. The Syntana-Utah facility development adds little to the overall regional environmental impact when considered in the context of the foregoing anticipated projects. With extensive environmental baseline efforts already performed as part of the Federal Prototype Lease Program, only a limited amount of site-specific environmental data will have to be developed by this project. The mine and surface retorting facility plant design will comply with best available control technology, and all requirements — federal, state, and local — as they relate to air and water quality standards.

SOCIOECONOMIC IMPACTS

Proposed location of Syntana-Utah Unit #1 is approximately 45 miles southeast of Vernal, Utah and 25 miles southwest of Rangely, Colorado. Rangely has approximately 2,000 residents and Vernal approximately 20,000. In view of the anticipated development programs soon to begin in the eastern Uintah County region, the Uinta Basin Energy Planning Council in cooperation with state and federal officials, has proceeded with the examination of alternatives for creating the appropriate infrastructure to support the projected industrial development. Syntana-Utah is aware of these activities and its development plan includes appropriate consideration of infrastructure development necessary to create a new grass-roots facility in the designated region.

Workforce and Population Generated by Syntana-Utah Project

Mining	500
Processing	325
Primary	1,500
Secondary	650
Population Expansion	4,000

PROJECT HISTORY AND STATUS

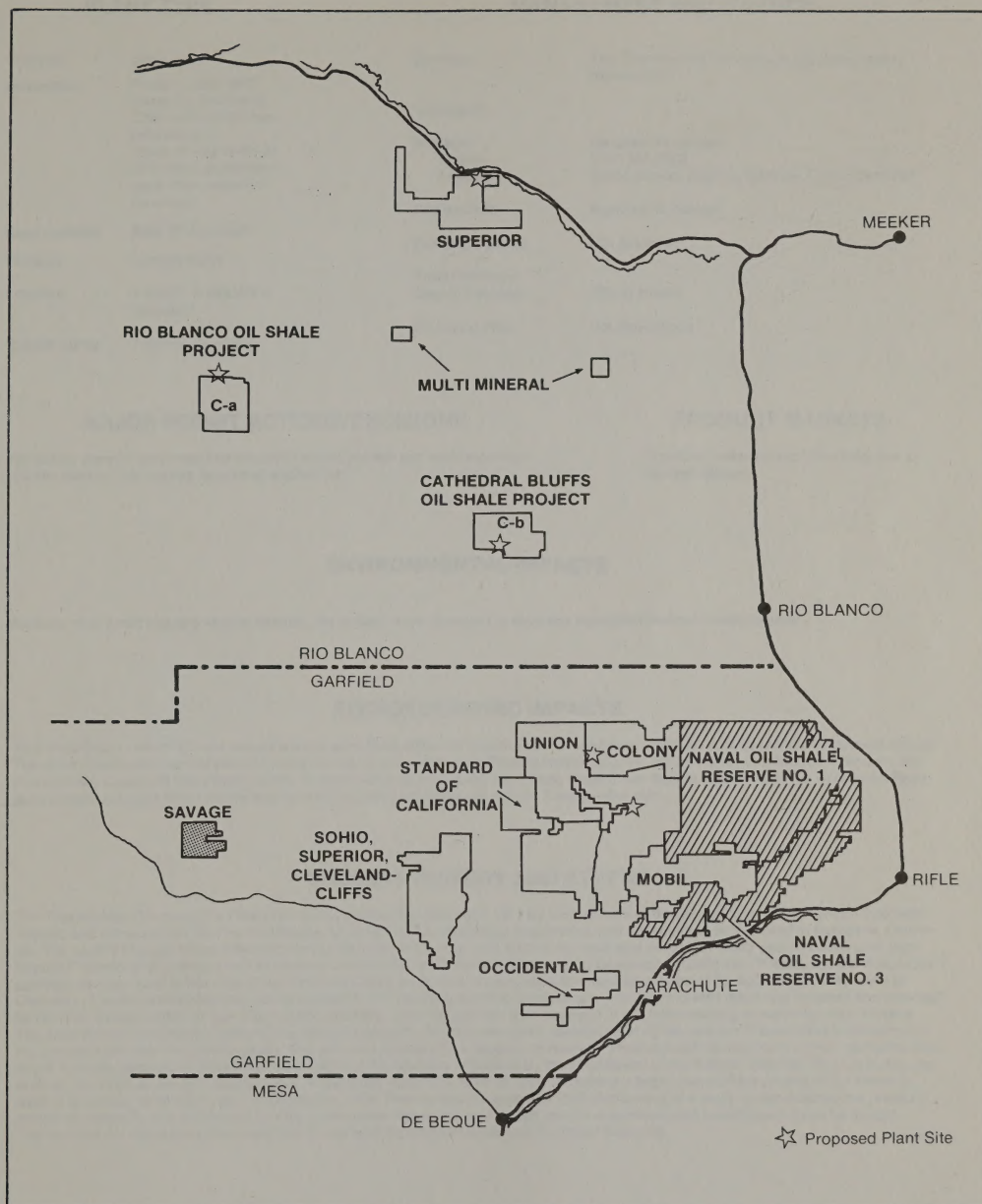
In 1979, the Synthetic Oil Corporation of Oklahoma City was formed to pursue the development of facilities leading to production of a refinable crude derived from Utah shale resources. The founders of Synthetic Oil Corporation, in turn, negotiated access to state-owned mineral leases in Utah as the basis for the available resource. In the third quarter of 1980, the Synthetic Oil Corporation was joined by Quintana Minerals Corporation of Houston, Texas, the two corporations forming a new joint venture known as Syntana-Utah. Syntana-Utah in turn was chartered to pursue the same objective as initially defined by the Synthetic Oil Corporation; however, in pursuit of this objective, the joint venture now draws on a broader base of management, technical and financial resources to develop a new private sector venture. An initial business plan of the joint venture was prepared in August 1980, and in October 1980 the Utah Department of Natural Resources, Division of Land and Forestry, was advised as to the long-term oil shale commercialization objectives of the joint venture. Subsequently, Syntana-Utah gave its approval for initial activities supporting the facility development, with fourth quarter 1980 activities concentrating on further quantification of the in-place resource location and assay as well as first efforts to develop an engineering definition of both the deep mine and surface retorting facilities. The project management for Syntana-Utah Unit #1 is currently seeking support from DOE under the provisions of P.L. 96-304 for support via grant award of continuing feasibility studies for the facility during CY 1981. The project management has submitted a proposal to the U.S. Synthetic Fuels Corporation with a request for financial incentive support to continue project development with total capitalization, to represent a combination of private financial sector funding with that of the U.S. Synthetic Fuels Corporation.

PROJECT/PROCESS DESCRIPTION

Syntana-Utah currently is evaluating several mature surface retorting technologies which might be used as the basis for design and construction of Unit #1, including those made available for license by PARAHO, Superior Oil, TOSCO, and Lurgi. The Unit #1 facility will consist of a deep mine and surface retorting plant. The surface retorting facility currently is anticipated to be based on the utilization of individual retorting modules having input capacities in the range of 4,000 to 10,000 TPD of shale ore. An engineering/economic decision yet to be made is the selection of the specific number of modules to be associated with the Unit #1 facility. The business plan was structured around early evaluation and selection of a preferred surface retorting technology. This was to be followed by the detailed design of mine and surface facilities, with required permitting to be initiated in CY 1981, and initial site work, long-lead procurement, and surface facility and mine construction to be initiated in CY 1982.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

(Not Available)



COLORADO

PROJECT/PROCESS DESCRIPTION

The Thermo-Mist property lies between Carr and Roan creeks near their confluence in Garfield County, Colorado (T 5&6 S, R 99&100W). The oil shale deposits are on parts of 4-A Mountain and Henderson Ridge. The property contains 3,510 acres, of which 2,510 are patented and 1,000—contiguous to the south on 4-A Mountain—are unpatented. The estimated recoverable shale oil is 50 million barrels from the patented portion and 54 million from the unpatented. Phase I, for which funding is currently sought, includes an underground mine, a one-module, commercial-scale, 2,000 BPD Thermo-Mist retort, a spent shale disposal site, and other needed facilities. The mine entry will be on the face of the cliff at the Mahogany Ledge on the north side of 4-A Mountain. The retort also will be on the north side. Spent shale will be placed in a carefully prepared side gulch. The Thermo-Mist retort is a gravity-flow, vertical kiln type that more closely resembles the Paraho retort, which it antedates, than other types of surface retorts. The owners feel it has features which should ensure superior heating of the shale, ease of operation, comparatively inexpensive construction and operation, and a relatively brief construction time. The retort process does not consume water, and Thermo-Mist's water rights should be adequate for the three development phases. Phase II will provide additional production from the patented land. Phase III will develop the presently unpatented land when patent has been obtained.

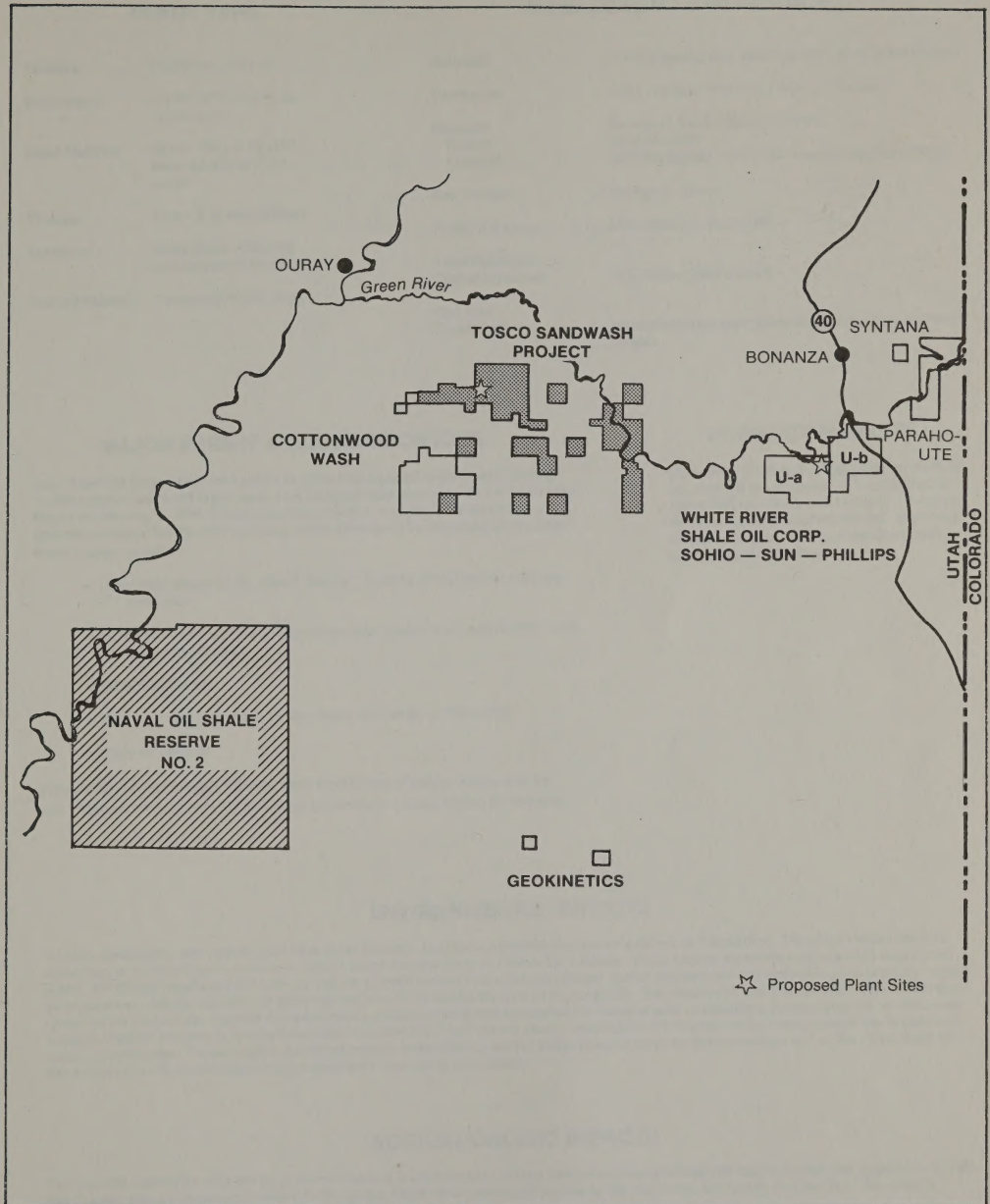
The owners estimated cost of the 2,000 BPD Phase I project is \$25 to \$30 million, depending upon the extent of onsite oil upgrading. The amount recently proposed to DOE for a grant to (1) prepare preliminary designs, (2) estimate costs, (3) study marketing, (4) determine economic feasibility, and (5) conduct all environmental and socioeconomic studies preparatory to applying for permits and determining the environmental controls needed was \$1.84 million (in late 1981 dollars). Production of shale oil from the center of the Piceance Basin will require sinking deep shafts or excavating giant open pits, demanding many years of lead time and huge investments before operation can begin. The owners feel there are no technical reasons why the peripheral areas cannot be brought into production quickly with mine access from outcrops. Analysis shows that when rapid recovery (between now and the year 2000) rather than total reserves is considered, 80 percent of the near-term recoverable reserves lie in the peripheral areas. These have greater potential for development as small operations.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

ACTIVITY	1981	1982	1983	1984	1985	1986
Feasibility Study	██████████					
Final Design			██████████			
Permitting		██████████	██████████			
Mine Development				██████████	██████████	
Plant Construction				██████████	██████████	
Operation						██████████

(Depends on feasibility study)

Tosco Sand Wash



UTAH

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Upgraded shale oil	Sponsor:	Tosco Development Corporation - Sand Wash Project
Production:	47,000 BPD project on 14,688 acres	Contractor:	TRW, Harrison Western, Ralph M. Parsons
Input Material:	66,000 TPD of 35 GPT shale, 12,000 AF/Y of water	Manager:	George C. Kane, Project Director
		Phone:	(303) 831-4567
		Location:	1600 Broadway, Suite 1400, Denver, Colorado 80202
Process:	Tosco II Surface Retort	Key Contact:	George C. Kane
Location:	Uinta Basin, Utah (35 miles south of Vernal)	Funds Expended:	\$4.3 million through 1980
Current Status:	Permitting, basic design	Total Estimated Capital Required:	\$1.5 billion (1980 dollars)
		Status of Financing:	No lenders have been identified due to early stages of project

MAJOR PERMIT ACTIONS/DECISIONS

Utah Board of State Lands was asked to unitize 29 state oil shale leases totaling 14,688 acres in the Sand Wash area. This unit plan was approved by the State Land Board on January 7, 1976. Project planning, design, and permit acquisition for a commercial scale facility is proceeding. Major permits to be acquired for the Sand Wash Project include:

- Utah State Board of Oil, Gas & Mining - Surface rehabilitation plan and mine plan
- BLM - Rights-of-way for products pipeline, power lines, conveyors, roads, and water supply
- EPA-PSD Permit
- EPA and state-approvals for any water discharge or reinjection
- State air permits.

Potentially, permits may be required from the Bureau of Indian Affairs and the Ute Tribe due to rights-of-way and close proximity to Uintah Indian Reservation.

PRODUCT MARKETS

Most likely a low sulfur hydrotreated shale oil product will be produced to be pipelined to either Salt Lake City or a midwest market via Rangely. Local markets preferred. Marketing outside of region heavily dependent upon availability of exchanges.

ENVIRONMENTAL IMPACTS

Actions leading to a site-specific EIS have been initiated. Detailed environmental impact analysis is proceeding. The plant should have no discharge of liquid effluents (similar in design to the Colony plant in Colorado), however, there may be temporary disposal of excess mine water. Air effluent discharge will comply with all current federal and state regulations. Sulfur compounds and ammonia generated are routed to processing units for recovery of elemental sulfur and ammonia for sale as by-products. The disposal of spent shale will cause land disturbance at the project site. Topsoil will be removed ahead of filling and stockpiled for reuse in land reclamation. Revegetation of all disturbed areas is planned and would re-establish wildlife habitat disturbed during plant construction. No impact on the agriculture of the largely arid region is anticipated. Construction of a water impoundment facility on the White River to serve oil shale development in the Uinta Basin is the subject of an Environmental Impact Statement now being processed.

SOCIOECONOMIC IMPACTS

The current estimated population of Uintah County is 20,200 based on the 1980 U.S. census household count. Vernal, the largest city in Uintah County, has a population of about 6,500. About 10,000 new permanent residents will move into the region as a result of this project.

PROJECT HISTORY AND STATUS

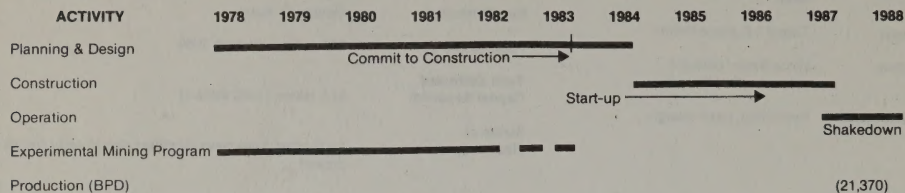
The project is in a planning and environmental analysis phase. Planning work and the design for a shaft and experimental mine are in progress. A pilot core hole was completed at the proposed site of the shaft. An estimate for a single module plant was also prepared. Tosco has demonstrated the retort process technology at Parachute Creek, Colorado, in a 1,000 TPD semi-works plant. A detailed commercial design for a 66,000 TPD plant performed for Colony has been applied to the Sand Wash site.

Tosco Sand Wash

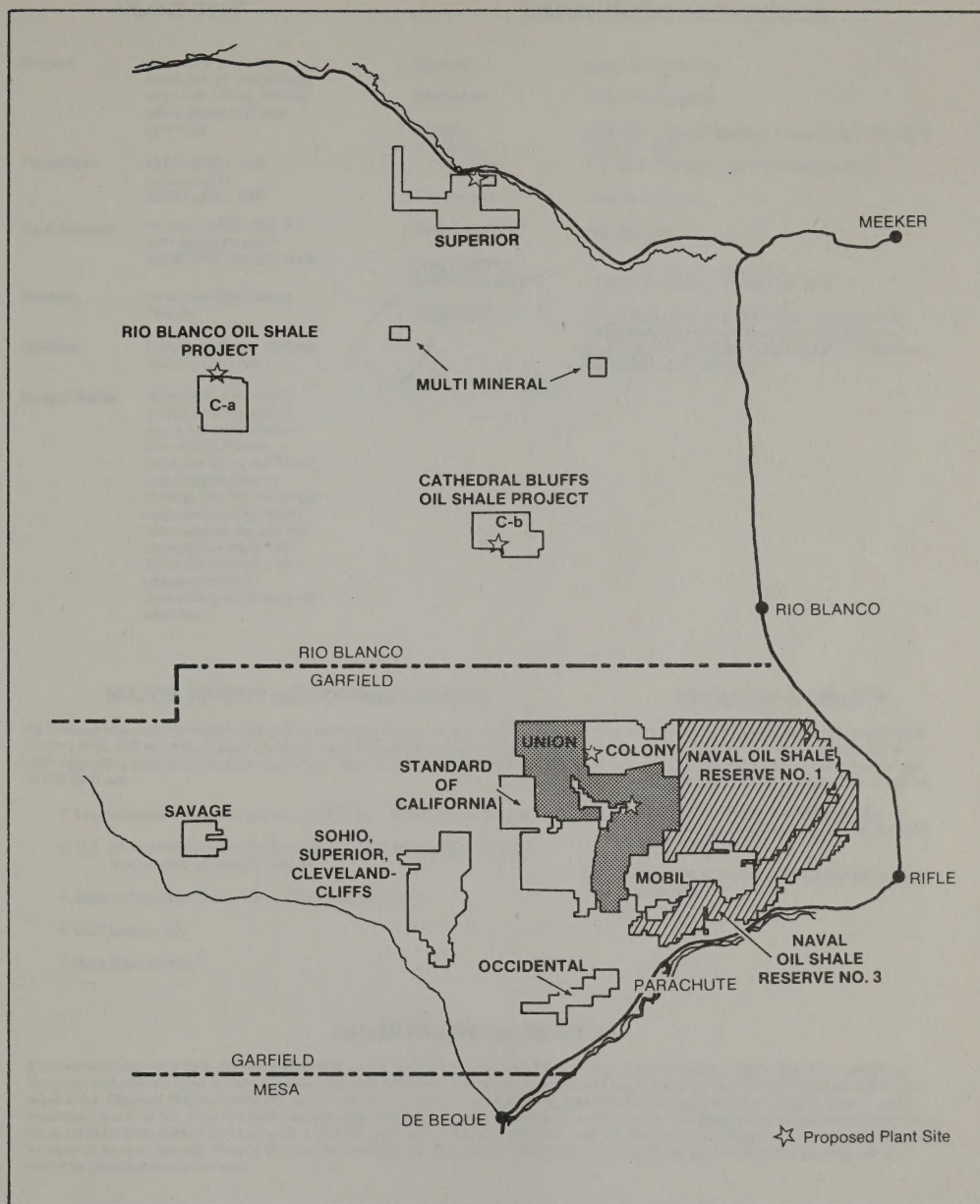
PROJECT/PROCESS DESCRIPTION

The Sand Wash project plans to utilize a form of underground room-and pillar mining, TOSCO II retorting and conventional refining methods to produce a premium quality synthetic oil. The TOSCO II process recovers 100 percent of the hydrocarbons contained in the mined oil shale as reasoned by Fischer Assay. The mine will draw 35 GPT shales from 30 to 40 feet intervals 2000 feet underground.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES



Note: This schedule represents Tosco's estimates for the Sand Wash Project.



PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Upgraded shale oil yielding high percentage of jet fuel (JP-4), military grade diesel fuel, and syncrude.	Sponsor:	Union Oil Company
Production:	10,000 BPD - 1938 increasing to 50,000 BPD - 1987	Contractor:	Union Oil Company
Input Material:	Phase I - 2,500 TPD, 34 GPT shale; Phase II - 68,000 TPD, 34 GPT shale	Manager:	John M. Hopkins, President, Energy Mining Division
Process:	Union Up-Flow Retort Process	Phone:	(213) 977-6437
Location:	Parachute Creek, Garfield County, Colorado	Location:	P.O. Box 7600, Los Angeles, California 90051
Current Status:	All permits for Phase I 10,000 BPD mine and retort have been issued. EPA P.S.D. Permit, Colorado State Air Permit and Garfield County Special Use Permit for the upgrading facility have been applied for and are expected by early 1981. Road construction, site preparation and preliminary mine work are underway.	Key Contact:	John M. Hopkins
		Funds Expended:	Not available
		Total Estimated Capital Required:	Phase I & II-\$1.8 billion (1980 dollars)
		Financing Plan:	Union has proposed that the U.S. Synthetic Fuel Corporation assist in financing through advance payments and purchase commitments for Defense Department fuel purchases.

MAJOR PERMIT ACTIONS/DECISIONS

All licenses and major permits necessary to start construction of the 10,000 BPD, Phase I mine and retort have been obtained. Applications for a permit for the 10,000 BPD upgrading plant were made in September 1980. Permits critical to the Phase II 40,000 BPD are:

- Environmental Protection Agency (EPA) - PSD, RCRA, TSCA Permits
- U.S. Corps of Engineers (COE)/Bureau of Land Management (BLM) - Environmental Impact Statement
- State of Colorado - Mine Land Reclamation and APC
- COE Section 404
- BLM Right-of-Way

PRODUCT MARKETS

Phase I: Fractionation facilities will produce JP-4 at Parachute Creek, with additional volume available for further processing into military specification fuels at other refineries.

Phase II: In addition to military grade products, syncrude suitable for refinery feed will be produced.

Products will initially be shipped by rail, and tank truck.

ENVIRONMENTAL IMPACTS

Environmental baseline data gathering programs and engineering studies for Phase I have been completed. Applications for permits to construct and operate were initially submitted in April 1978. Environmental emissions will be in compliance with existing state and federal regulations. Disposal of spent shale will cause land disturbance at the project site. Revegetation of the entire area is planned and would reestablish much of the original wildlife habitat disturbed during plant construction and operation. Revegetation also will reestablish most of the grazing land for agricultural purposes. Union Oil Company and its consultants have performed environmental studies on the project site for most of the past decade. Results of these studies indicate there are no apparent environmental considerations that would preclude industrial development in the area.

SOCIOECONOMIC IMPACTS

The two counties expected to receive the major impacts of the proposed development have a combined population of 70,000—Mesa County about 55,000 residents and Garfield County about 15,000. The cities of Rifle, Parachute, DeBeque and Grand Junction also will be affected. These cities and counties also will be impacted by the Colony Development project which may closely follow the Union project. The severity of the impacts resulting from the proposed project will depend upon the interplay of Union's proposed activities (in particular, the size, earnings, and other characteristics of its work force), and the changing and complex nature of locally affected communities in the project region. New basic employment associated with the project consists of both temporary (construction-related), and permanent (operation-

Union

related) employment. Construction employment has begun and will continue for approximately six-and-a-half years. Average construction employment will be about 2,000 persons. Peak construction employment will reach about 4,700 during the fourth quarter of 1986. The mix of required skills will change from quarter to quarter, but about 75 percent of the total work force will be skilled workers. Operational employment will begin in the first quarter of 1983 with 350 workers and increase to about 1,100 starting in mid-1987. Operational employment will remain at this level until project termination.

PROJECT HISTORY AND STATUS

- 1920s - Union began acquiring oil shale lands in Western Colorado.
- 1955 - A 3-1/2-year research and development program began at Union's Parachute Creek, Colorado site to demonstrate oil shale mining and retorting and shale oil upgrading technology. Detailed engineering studies related to commercial operation commenced.
- 1957-58 - Union's "Upflow Retort" was successfully demonstrated at the 1,200 TPD level.
- 1961 - 15,000 bbls shale oil (obtained from Parachute Creek runs) upgrading and refining demonstration run was made at the American Gilsonite Refinery at Fruita, Colorado.
- 1974-77 - **Prototype Shale Oil Plant**
Process comparisons, economic evaluations and capital cost estimates for various shale oil facilities were performed, ranging from a 1,500 TPD demonstration plant up through a 50,000 BPD syncrude plant. Major improvements were achieved in the Union upflow process to increase capacity and reduce costs. A complete 10,000 TPD prototype oil shale plant, including facilities from the mine through unit train marshalling yard, was developed, together with capital and operating costs. In 1977, engineering studies were performed to upgrade the test unit.
- 1977-79 - **Experimental Oil Shale Plant**
Engineering Design Specifications and Cost Estimate for a 10,000 TPD experimental oil shale mine and retorting plant were developed. The plant was to be located in the Parachute Creek area near Grand Valley (now Parachute), Colorado. This plant was to test Union Oil's upflow rock feeder and retort, producing about 9,000 BPD shale oil. Included with this development work was the preparation of the necessary documents to secure the major environmental permits.
- 1979 - **Semiworks Rock Feeder Test Facility**
A semiworks rock feeder was designed, fabricated and constructed on Union Oil Company's property in the Parachute Creek area near Grand Valley, Colorado. This semiworks rock feeder was operated in order to evaluate the performance resulting in the scale-up design capability to a full-size rock feeder.
- 1980 - **10,000 BPD Retort Plant**
Based on information developed in the last five years, detail engineering and design were started on the development of a 10,000 BPD retort plant. Included in this work are the development of a mine and upgrading plant to support the retort operation.
- 1980 - **50,000 BPD Oil Shale Plant**
Based on the Experimental Retort Plant, work has started on the development of a 50,000 BPD oil shale retort facility complete with mine and upgrading plant auxiliary facilities.

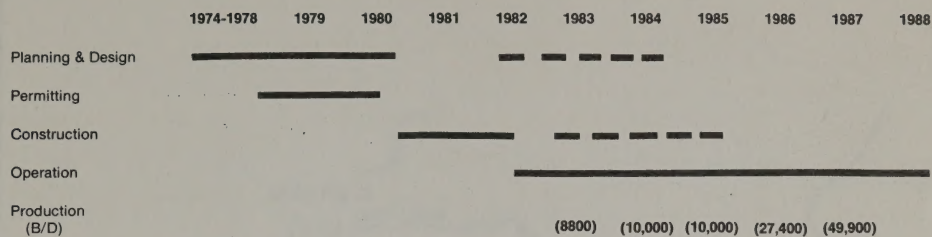
PROJECT/PROCESS DESCRIPTION

Union Oil believes that commercial development of its property could produce shale oil up to the 150,000 BPD level for more than 25 years. Located on Parachute Creek, Garfield County, Colorado (T5, 6S, R8W), the property is estimated to contain two billion barrels of shale oil recoverable by today's technology. Union presently is planning a 50,000 BPD facility to be started with one commercial module at the 10,000 BPD level, possibly by 1983.

Union's water supply will come from the Colorado River and be impounded in a reservoir on Parachute Creek. The mine will be underground room-and-pillar and produce 68,000 TPD at the 50,000 BPD capacity.

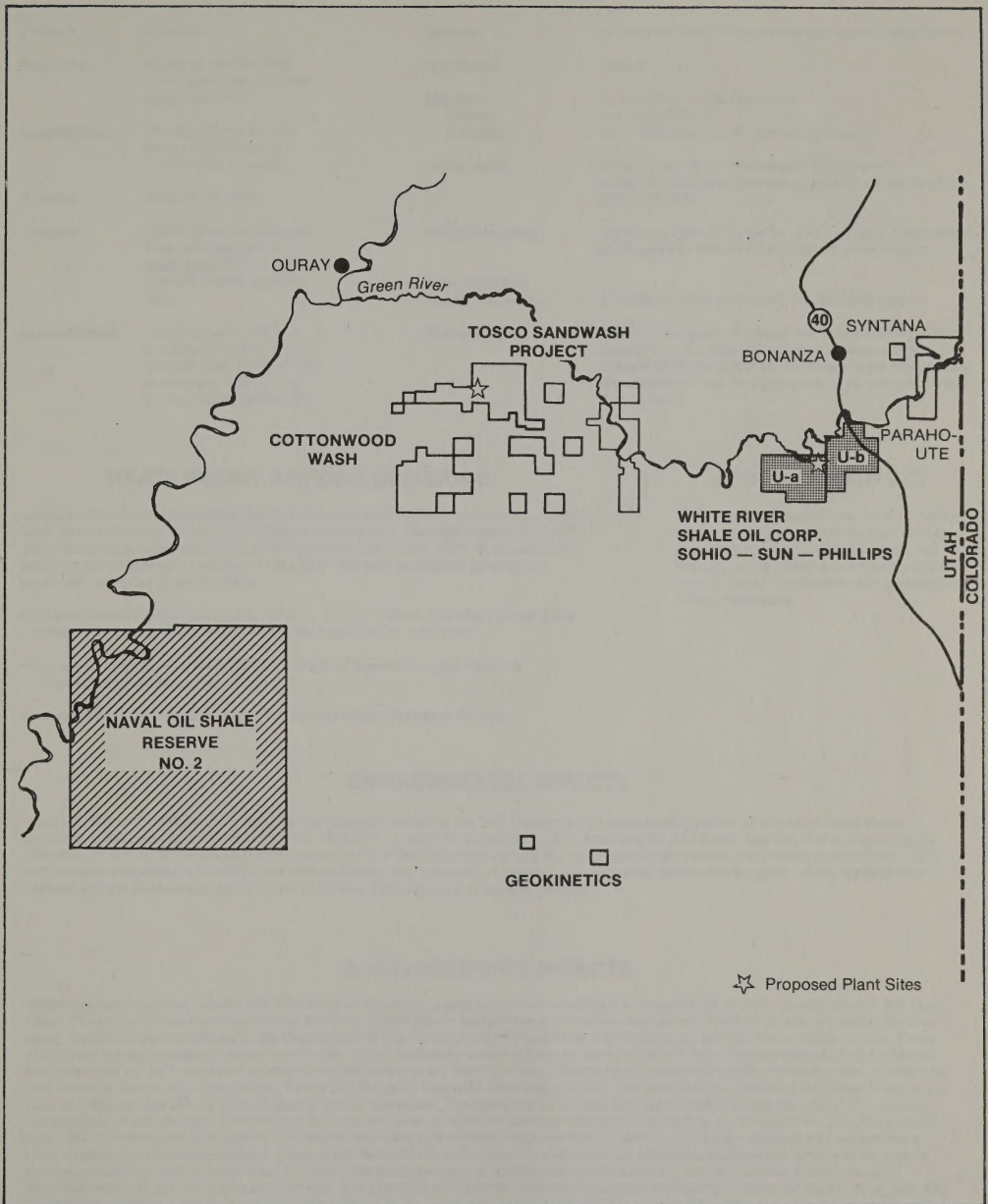
Union's upflow retort is a vertical cone. Crushed shale is fed into the bottom and forced up through the vessel by the rock pump. Recycle gas, heated in an external fire heater to 950° F, is forced into the top of the retort by a compressor and flows downward through the shale. The hot gas decomposes the kerogen in the shale, producing oil and gas which flow downward over the incoming cool shale, preheating the shale and condensing and cooling the oil. The oil and gas are drawn off the lower part of the cone. The retorted shale flows off the top of the cone, is cooled and then moved by conveyor to an ore pass for disposal.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES



Note: Schedule is contingent upon federal \$3.00/bbl. tax credit. Union proposes to build a 10,000 B/D Experimental Shale Oil Plant and expand to 50,000 B/D after "B" Retort is proven.

White River (U-a, U-b)



UTAH

PLANT TYPE

MANAGEMENT AND FINANCE

Product:	Shale oil	Sponsor:	White River Shale Project (Phillips, Sunoco, and Sohio)
Production:	50,000 to 100,000 BPD contingent upon commercial economics	Contractor:	Bechtel
Input Material:	179,000 TPD of 28 GPT shale rock; 13,000 to 27,000 AF/Y of water	Manager:	C. E. Doney, Project Manager
Process:	Surface retorting	Phone:	(801) 328-3700
Location:	10,240 acres; contiguous Federal Prototype Oil Shale Lease Tracts U-a and U-b, Uintah County, Utah.	Location:	1315 West Highway 40, Vernal, Utah 84078
Current Status:	Activities suspended pending clearance of property title. DDP update in progress. Environmental monitoring continuing.	Key Contact:	Rees C. Madsen, Administrative Coordinator James W. Godlove, Environmental Affairs Coordinator (801) 789-0571
		Funds Expended:	Combined Bonus Payments - \$72.4 million; Environmental Programs - \$9 million; Engineering - \$8 million.
		Total Estimated Capital Required:	\$3.0 billion (1980 dollars) for 100,000 BPD facility
		Financing Plan:	Phillips Petroleum Company and Sunoco Energy Development Co., are requesting loan guarantees in the amount of 60 percent of those Project costs representing the commitment of the Applicants, or 40 percent of total Project costs.

MAJOR PERMIT ACTIONS/DECISIONS

As required by lease agreements, detailed environmental baseline monitoring studies have been conducted on tract. The Detailed Development Plan was submitted in 1976 and is being updated at this time and will be submitted in June 1981. Progress on the project is contingent upon approval of the DDP and receipt of other government approvals, examples of which follow:

- Environmental Protection Agency (EPA) — PSD Air Permit, National Pollutant Discharge Elimination System Permit (will be submitted in June 1981)
- Bureau of Land Management (BLM) — Right of Way for Support Facilities Approval of White River Dam Project
- Utah — Mined Land Reclamation Plan, Air and Water Discharge Permits

PRODUCT MARKETS

During modular operations shale oil product will be trucked to nearby markets. During commercial operations shale oil will be transported by pipeline to refineries principally in Texas. Onsite product upgrading is being investigated.

ENVIRONMENTAL IMPACTS

The Final EIS for Prototype Oil Shale Leasing Program issued by the DOI (August 1973) assesses impacts of all prototype lease tracts, including White River Shale Project (WRSP). However, through the completion of an extensive environmental baseline monitoring program (elements of which are continuing) and preparation of a Detailed Development Plan and various pre construction permit applications, significant impacts associated with WRSP activities are being fully assessed. A detailed environmental monitoring program will be implemented to evaluate project impacts and guide efforts to reduce and mitigate any adverse impacts.

SOCIOECONOMIC IMPACTS

WRSP has published two reports (1975) dealing with prevailing socioeconomic conditions and impacts of oil shale development in the Uinta Basin. These reports are being updated at this time. WRSP also is supporting a current socioeconomic study of growth impacts in the basin, being conducted by consultants to the Department of Energy and the Utah Department of Community and Economic Development. These reports will provide a basis on which community impact assistance decisions can be made by WRSP. It is currently planned that construction personnel will be housed in bachelor camp facilities located near the tracts. Operating personnel will reside in existing nearby communities, primarily Vernal, Utah (population, 7,000) and Rangely, Colorado (population 2,500). The work force to construct the Phase I facility will peak at 1,500 persons during 1983, dropping rapidly thereafter. The operating work force will be comprised of approximately 850 persons. Construction of later phases of the Project will require a peak of 4,000 persons by 1988 and an operating work force of about 3,200 persons after 1993. Construction of the facility will require the influx of a relatively large number of skilled construction workers into northeastern Utah. Project operations will produce steady, long-term growth in the area. To help minimize adverse socioeconomic effects in the area, a temporary campsite will be established to provide housing, services, and recreation for construction workers, and for those indirectly employed who will provide goods and services. The campsite will consist of modular, transportable bachelor units and eating, shopping, and recreational facilities. It will be naturally landscaped to fit the terrain and will provide modern utilities. Since the campsite will be nearly self-sufficient, there should be minimal increases in demand for other local services. Plant and mine operations begin to make a major contribution to employment in 1985, when the operations work force reaches 850. Since the operations employment at full commercial production will be stable over a long period of time, this population is expected to be assimilated into the local communities. This will result in an expansion of housing and population in the area. Every effort will be made to work with local, state, and federal officials to assure that the transition is smooth.

White River (U-a, U-b)

PROJECT HISTORY AND STATUS

On March 12, 1974, Sun and Phillips were awarded Oil Shale Tract U-a (5,120 acres) by closed bid sale from the U.S. Department of Interior for \$75.6 million to be paid in five equal installments. Shortly thereafter Sohio joined Sun and Phillips to form the White River Shale Oil Corporation (WRSOC). On April 9, 1975, WRSOC was awarded Tract U-b (5,120 acres) for \$45.1 million, which is contiguous to Tract U-a. Tract U-a has been fully assigned to Phillips and Sunoco Energy Development Company. Tract U-b has been fully assigned to Sohio Shale Oil Company. The White River Shale Project was formed to represent the three companies and to plan for joint development of the two Utah tracts. Under the lease terms, a Preliminary Development Plan was submitted to the Area Oil Shale Supervisor's (AOSS) Office in May 1974. The Detailed Development Plan was submitted to AOSS in June 1976. The lease terms were administratively suspended for one year in November 1976 because high levels of naturally occurring air pollutants were measured on the tracts. Prior to expiration of the administrative suspension, the terms of the lease were suspended by a court-ordered injunction issued in May 1977. This action was taken by WRSP in light of two severe title questions regarding legitimacy of federal ownership of the two tracts. This injunction is still in full force although progress is being made toward resolution of the issues which continue to cloud the title to Tracts U-a and U-b. Environmental monitoring activities have continued on the tracts during the suspension period. In April 1980 WRSP commenced engineering studies to update project development plans and prepare an updated version of the Detailed Development Plan (DDP). The DDP will be submitted to AOSS in mid-1981 for approval.

PROJECT/PROCESS DESCRIPTION

Federal Prototype Oil Shale Tracts U-a and U-b are located at the eastern edge of the Uinta Basin in northeastern Utah. The combined tracts have a total surface area of 10,240 acres and a potential recoverable shale oil reserve of 700 million barrels. The DDP being updated at this time summarizes WRSP's proposed development scenario for Tracts U-a and U-b as follows:

1. Joint development of both tracts.
2. Phase development of the resource to thoroughly investigate available mining, retorting, and processed shale disposal technologies:
 - Phase I - Modular program mining up to 30,000 TPD of shale rock and producing up to 15,000 BPD of shale oil.
 - Phases II & III — Progressive commercial development program culminating in the mining of up to 179,000 TPD of shale rock and producing up to 100,000 BPD (nominal) of shale oil.
3. Room-and-pillar mining technology to be used.
4. Surface retorting technology used to process both coarse and fine shale rock.
5. Surface disposal of processed shale on tract planned with appropriate land rehabilitation program implemented.
6. Product upgrading facilities are being investigated for the commercial phases of the project.
7. Primary water source would be the State of Utah's proposed White River Dam and Reservoir.

ACTIVITY SCHEDULE/PRODUCTION ESTIMATES

(A schedule cannot be realistically prepared at this time. Upon resumption of field activities the schedule would reflect the time needed for demonstration of candidate retorting technologies. This will be needed prior to the design and construction of a commercial facility. Based on this need, commercial production of shale oil would probably occur some nine years after beginning mining operations for the technology demonstration program.)

